

A stylized illustration of a wooden utility pole. The pole is vertical and textured, with two horizontal cross-arms. Each cross-arm is supported by two diagonal braces. Each cross-arm holds six dark, rounded insulators. From each insulator, a thin, dark line extends outwards, representing a power line. The lines radiate from the pole, filling the background. The entire illustration is rendered in a simple, graphic style with a limited color palette.

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1081. SCOTLAND DICKINSON EMMET ROSSETT WINNEBAGO WORTH MITCHELL HOWARD WINNEBAGO ALLAMAKEE

CLAY PALO ALTO HARCOCK CERRILLO FLOYD CHICKASAW

BROWN FREMONT POCAHONTAS HUMPHREY WRIGHT FRANKLIN BUTLER BREMER

WEBSTER

BLACK HAWK DICKMAN DELAWARE DESMOINES

WOODBURY IOWA SAC CALHOUN HAMILTON HADSON GEORGETOWN

BOONE

CRAWFORD CASSROLL GREENE BOONE STORY MARSHALL

TAMA BENTON LEE

JONES JACKSON

CLINTON

HARRISON SHELBY AUDUBON GRANT RALLAS POLK JASPER POWESHIRE IOWA JOHNSON

OSAGE

SCOTT

POTTAWATTAMIE CASS ABRAHAM MADISON WARREN MARION MARSHALL KEOSAUQUA WASHINGTON

LOUISA

SMITH MONTGOMERY ADAMS BRIGHAM CLAREE LUCAS MONROE WAPELLO JEFFERSON HENRY

DES MOINES

FREMONT PAGE TAYLOR RINGGOLD DECATUR WAYNE APPANOOSE DAVIS VAN BUREN

LEE

AE 785

PROGRESS REPORT
on
THE UTILIZATION OF ELECTRIC SERVICE
IN THE
RURAL AREAS OF IOWA

1947 through 1951

Compiled

by

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1952-53

Agricultural Experiment Station
and
Agricultural Extension Service

Iowa State College

Ames, Iowa

ACKNOWLEDGEMENTS

The Agricultural Experiment Station and the Agricultural Extension Service, in cooperation with various Departments of the Iowa State College, directed this study on "The Utilization of Electric Service in Rural Areas in Iowa."

The funds for this program were provided through a cooperative agreement between the Iowa Utilities Association and the Iowa State College.

In addition to the committee members and project personnel mentioned on the following pages, the authors are grateful to all power supplier personnel, county extension directors, home economists and others who had a part in carrying out the objectives of the overall program.

Special credit is due to H. H. Beaty, S. S. DeForest and E. R. Johnson who, as former project personnel, made major contributions to these studies.

Eleven Iowa farm families have contributed important information and data towards the fulfillment of this program. Without such excellent cooperation much of this work could not have been done and to these families we are indeed grateful:

Edwin Anderson	Audubon County
LaVerne Cutter	Page County
Lewis Hadsall	Jasper County
Edwin Helming	Woodbury County
George Hora	Washington County
Clarence Hotz	Webster County
Roy Kramer	Black Hawk County
Phillip Mahr	Warren County
Loraine Meier	Clayton County
Merwin Smith	Dickinson County
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This publication covers the various phases of work on the Rural Electric Demonstration Farm Program formerly entitled "The Utilization of Electric Service in the Rural Areas of Iowa," and listed as projects 1079 and 1081. Organizations cooperating on this project with the Iowa Agricultural Extension Service and the Iowa Agricultural Experiment Station were the Iowa Utilities Association and rural electric co-operatives.

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INTRODUCTION

Central station electrical service was reported available to 95.8 percent of the 203,159 farms in Iowa on June 30, 1951¹. Only 84.2 percent of all farms in the United States were reported as having electrical service available for their use. Iowa was well ahead of the average, with only one state, Michigan, having a higher percentage (97.7) of the farms with electric service. In Iowa nearly 64 percent of the farms were served by rural electric cooperatives and 36 percent served by private utilities and municipal plants². The private utilities and municipal plants furnished 46 percent of the power consumed on the rural electric cooperative lines. Thus, more than 65 percent of the power consumed on the farms was produced by private utilities and municipal plants.

On farms receiving central station service in the Eastern Livestock Area of Iowa, electrical energy consumption increased from an average of 812 KWH per year per farm in 1938 to 2,174 KWH per year per farm in 1947³. In the first 9 years of this period, the annual increase was about 9.6 percent, but in 1947 the electrical energy consumption increased 30 percent. This accelerated trend has continued; consequently, the predicted doubling of consumption by 1960 should be reached much earlier.

The average electrical energy consumption for Iowa in 1951 was 3,380 KWH per year per farm⁴. Well over half a billion kilowatt hours of electricity were used on Iowa farms in 1951.

The investment for electric service in Iowa, including generating plants, transmission and distribution lines in urban and rural areas was estimated at nearly \$1 billion. In addition to this investment, about one-fifth of a billion dollars has been invested by the farmers in farmstead and building wiring and in equipment on the farm.

Iowa farmers paid son \$20 million to power suppliers in 1951 for the electrical energy that was used. When compared to 1938, four times as much money was spent for electrical energy, but seven times as many kilowatt hours were purchased.

¹U.S.D.A. Report of the Administrator. Rural Electrification Administration. 1951.

²Iowa State Commerce Commission Report. March 15, 1951.

³U.S.D.A. Circular 852. Electricity on Farms in the Eastern Livestock Area of Iowa. September, 1950.

⁴U.S.D.A. Release No. 1902 - 52. August 28, 1952.

Research in farm electrification has made the investment by farmers and power suppliers pay off in increased production, reduced labor requirements and a higher standard of living. In the late 1920's knowledge gained from the rural electrification project at Garner, Iowa, was instrumental towards forming specifications for early "farmer-built" lines and rural electric cooperative lines. The use of three-wire 230-volt service, 60-ampere entrances, as required in 1951 by many specifications, and transformers of ample size contributed considerably toward the ability of the farm distribution system to carry heavy loads imposed 5 to 10 years after the initial construction was completed. Iowa farmers have saved at least \$80 million in rewiring costs as the result of their use of #8 or #6 wire rather than #10 or #12 (A.W.G.) wire for building service drops. Tests and reports on existing equipment by Iowa State College have often led to the redesign and standardization of equipment, such as ranges and welders.

Recent research has continued to raise the standard of living on the farm by showing the farmer various ways of increasing production at lower costs. Consequently, farmers have rewired their farms to make more efficient use of new and better equipment. Power suppliers have rebuilt lines and increased voltages on their distribution and transmission systems. They have increased and improved generating capacity to meet the demand of rural customers for more power at lower costs.

Iowa research in farm electrification has been under way on four major phases. A pilot study on the demand and diversity of farm electrical load on 16 farms near Marshalltown was completed in 1951. Plans were made and equipment ordered for expansion and continuance of a related demand and diversity study. Investigations were initiated in 1951 to determine the optimum temperature of water for maximum swine production coincident with economical electrical energy requirements of the watering units. Studies were continued on insect control, particularly the European corn borer, with units utilizing ultraviolet radiations. These fundamental research projects were in addition to the numerous applied research investigations conducted as part of the program reported herein.

The "Utilization of Electric Service in the Rural Areas of Iowa" program provided for the selection of electrification demonstration farms to be distributed in the five general farming areas. These farms were located as follows:

<u>Area</u>	<u>County</u>
Eastern Livestock	Marshall, Washington and Jasper
Southern Pasture	Warren
Western Livestock	Page, Audubon and Woodbury
Cash Grain	Dickinson and Webster
Northeastern Dairy	Black Hawk and Clayton

These farms were selected by the county extension director, a local committee, a local power supplier representative and Iowa State College personnel.

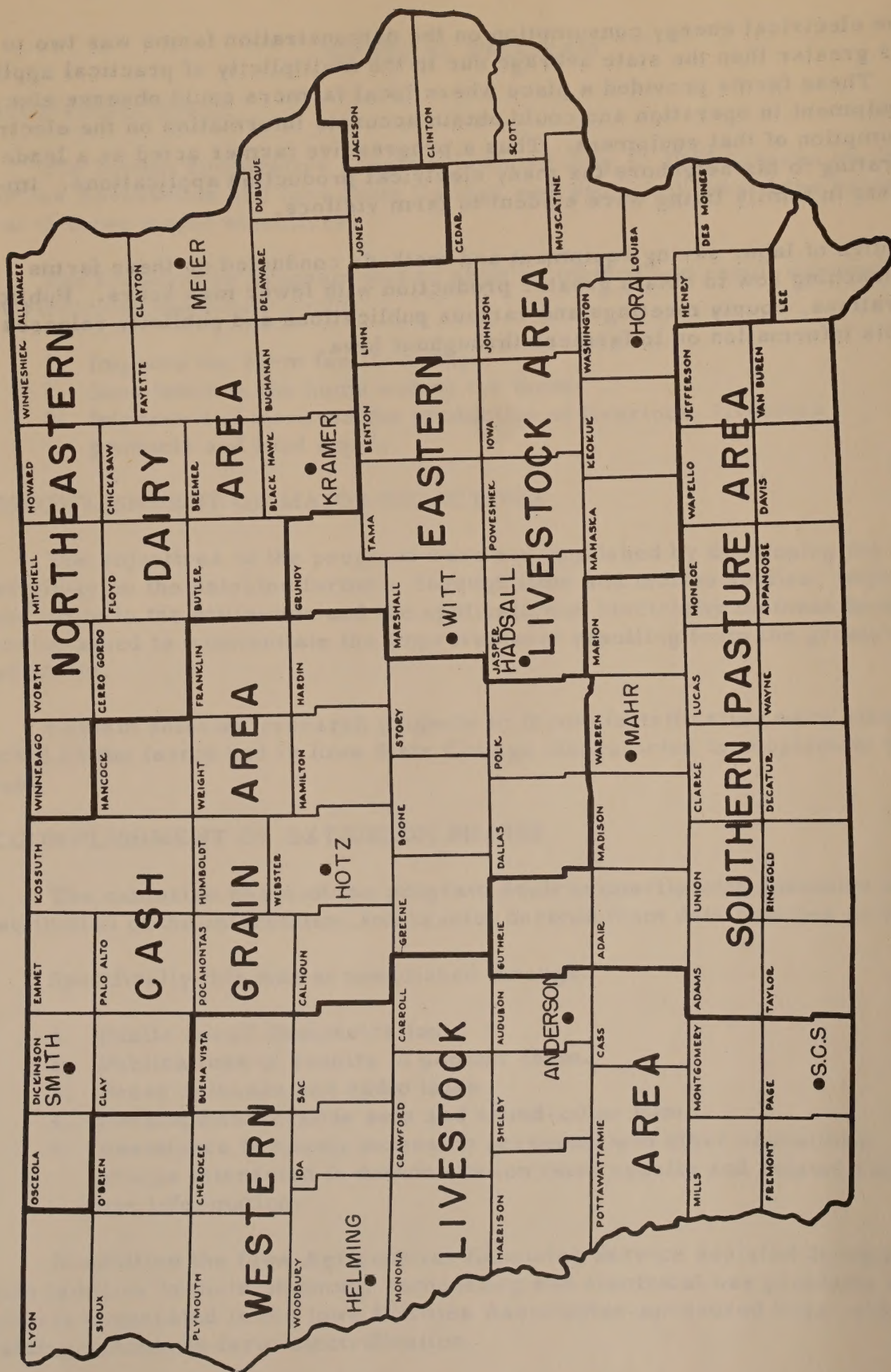
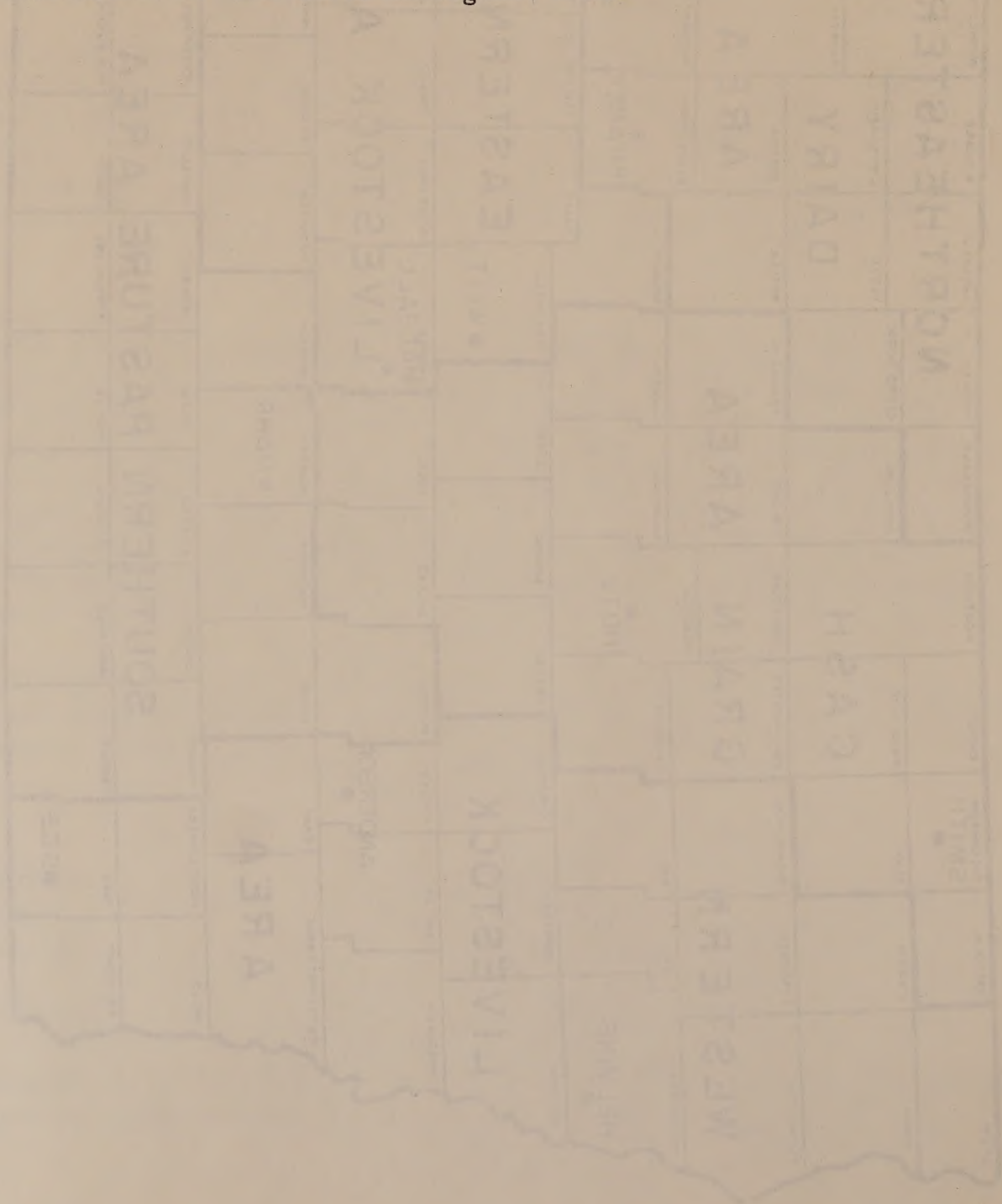


FIG. I LOCATIONS OF RURAL ELECTRIFICATION DEMONSTRATION FARMS.

The electrical energy consumption on the demonstration farms was two to six times greater than the state average due to the multiplicity of practical applications. These farms provided a place where local farmers could observe electrical equipment in operation and could obtain accurate information on the electrical consumption of that equipment. Thus a progressive farmer acted as a leader, demonstrating to his neighbors the many electrical production applications. Improvements in family living were evident to farm visitors.

Studies of labor saving equipment and methods conducted on these farms aided in teaching how to obtain greater production with fewer man hours. Public demonstrations, county meetings and various publications and publicity releases passed this information on to farmers throughout Iowa.



GENERAL PROGRAM

MAJOR OBJECTIVES

The 5-year cooperative program initiated July 1, 1947 between the Iowa Utilities Association and Iowa State College was projected toward the accomplishment of three major objectives.

The cooperative program was to show by method and result demonstrations how electrical equipment could:

1. Improve the farm family living.
2. Save labor in the home and on the farm.
3. Improve and increase the production of livestock, livestock products and food supply.

ACCOMPLISHMENT OF MAJOR OBJECTIVES

The objectives of the program were accomplished by developing the use of electricity on the selected farms. Through time and motion studies, improvements were made in the utilization and the application of electricity on these farms. Data were obtained to substantiate the improvements resulting from the greater use of electricity.

Certain selected research projects in farm electrification were also conducted on the farms and in Iowa State College laboratories to supplement the program.

ACCOMPLISHMENT OF EXTENSION PHASES

The extension phase of the program dealt primarily with education and with distribution of the information and results derived from data obtained on the farms.

Specifically this was accomplished through:

1. Public result demonstrations.
2. Publications of results in popular form.
3. Press releases and radio talks.
4. Development of slide sets and sound-color film.
5. Assistance to county extension personnel and other educational groups interested in demonstration farm results and related electrical use information.

In addition the Iowa Agricultural Extension Service assisted demonstration farm families in their planning, remodeling and electrical use problems and actively cooperated in the Iowa Utilities Association-sponsored boys' 4-H leader training schools in farm electrification.

ACCOMPLISHMENT OF RESEARCH PHASES

For expediency with cooperating college groups, the research phase of the program was divided into two parts. One of these dealt with the utilization of electricity in the home and the second with utilization of electricity on the farmstead.

Achievement was attained by:

1. Accumulation of electrical energy consumption data in the home, in the farming enterprise and on specific equipment.
2. Collection of supporting basic farm operation data.
3. Correlation and analysis of basic data obtained from farms.
4. Test and study of electrical farm equipment which gave promise of wide acceptance.
5. Modification and testing of equipment to meet specific farm requirements.
6. Publication of results of studies and tests in technical and popular form.

SUMMARY OF RESULTS

Eleven Rural Electrification Demonstration Farms, located in all five farming areas of Iowa, have cooperated in the program.

Twelve demonstrations were held with a total attendance of 2,720 persons.

Seven articles on farm electrical applications have been prepared for release through Iowa Farm Science. This publication has a monthly distribution of 22,000. In addition 29,900 reprints of these articles were distributed by the college and power suppliers. Also 55,250 copies of a wiring pamphlet were distributed.

Electrical energy consumption data on these farms indicated a usage 2 to 6 times the 1951 Iowa farm average of 3,380 kilowatt-hours (KWH) per year.

Two peaks in electrical energy consumption were apparent.. One major peak resulted from the lighting, heating and brooding load in late winter; a second minor peak from the refrigeration and freezing load in mid-summer.

The peak electrical energy consumption formerly occurring in January, resulting from mid-winter heating and lighting, has been increased in magnitude and extended through March and April. This change was attributed to the productive applications of pig and chick brooding and stock waterer heating loads.

The average electrical energy consumption of ranges in the farm homes was 113.3 KWH per month.

The data on storage type water heaters showed that 74 KWH were used to heat 225.0 gallons of water 94° F each month per person. This indicated that only 2.86 gallons of water were heated 100° F per KWH as compared to the theoretical value of 4.10 gallons per KWH. This was an overall efficiency of 70 percent for the hot water system in these farm homes under usual conditions.

The average electrical energy consumption of refrigerators on Rural Electrification Demonstration Farms was 31.1 KWH per month. Sizes ranged from 6 to 10.7 cubic feet.

The electrical energy consumption of home freezers averaged 4.67 KWH per cubic foot per month in sizes varying from 8 to 19.5 cubic feet. The make and location, rather than the size, seemed to influence the variations in consumption of 3.56 to 6.27 KWH per month per cubic foot.

Electrical energy used outside the farm home varied from 21 to 55 percent of the total consumption on the farms.

Losses in farmstead wiring varied from 1.6 to 6.2 percent for a several-month period. Monthly losses during chick brooding were as high as 17.4 percent on one farm due to heavy heating loads served with inadequate wiring.

Electrical energy consumption of shallow-well water pump motors varied from 1.56 to 2.16 KWH per 1,000 gallons of water pumped; consumption of deep well pump motors varied from 2.42 to 2.78 KWH per 1,000 gallons of water pumped.

The location of stock waterers, water temperature and type of waterer were considered the greatest factors contributing to the wide variation in electrical consumption. Season consumptions ranged from 106 KWH in a barn to 651 KWH in an open shed to 2,598 KWH in an open lot. Water temperature in the latter unit was found to be as high as 62°F.

The electrical energy consumption of milking machines varied from 1.6 to 2.1 KWH per month per cow for portable units. A pipe line milker, delivering milk directly to the can from the cow used 3.3 KWH per month per cow.

Night lighting for poultry laying flocks on two farms showed that 53 to 90 KWH per 100 birds per year were used.

Electrical energy required for grain elevation on one farm averaged 2.6 KWH per 1,000 bushels elevated during a 2-year period.

In an electric range vs. LP gas range test, 3.6 KWH were used per day as compared to 1.2 pounds of gas used per day.

Pig brooding data from 3 farms indicated that 18 to 37.5 KWH of electrical energy were used per litter of pigs brooded.

The electrical energy consumption for chick brooding varied from 55.5 to 303.8 KWH per 100 chicks brooded, the large variation being attributed to the number of chicks brooded per unit. A comparison between oil and electricity showed little difference in brooding costs. Brooding with electricity under usual conditions was considered more dependable and safer by the users.

Complete monthly data for all tables and graphs incorporated in this report were not available. For instance, on the Audubon County farm, electric meters were removed to facilitate remodeling of the home. On other farms some meters, especially the water meters, were found to be functioning improperly. This accounts for some missing data.

Detailed results are available in files in the agricultural engineering department at Iowa State College. These cover all of the above mentioned data.

DETAILED REPORT ON RESULTS

BASIS FOR FARM SELECTION

The rural electrification demonstration farms were selected on the basis of the following points:

1. The farm operator should own and be financially able to improve the farm.
2. The farm operator should have an electrification improvement program in mind.
3. The farm operator should be acknowledged as a leader in his community, use good established farming practices and be willing to try new methods.
4. The farm family should consist of middle aged adults and children.

Other points bearing on the selection included the availability of an all weather road to the farm and the ownership of an average amount of electrical equipment.

DESCRIPTION OF FARMS

Audubon County-Selected July 5, 1949. This 156-acre farm was located in the Western Livestock Area. One-hundred-forty-five acres were tillable, and were farmed on the contour with 11 acres in permanent pasture and farmstead. The annual livestock program included 125 hogs, 100 to 120 feeder cattle and 500 chickens. The total connected electrical load was 22.73 kilowatts on December 31, 1951. The family was comprised of two adults, four boys and four girls, but only one boy and three girls were still residing on the farm. This was the sixth farm selected to take part in the program.

Black Hawk County-Selected August 19, 1948. This 160-acre farm was located in the Northeastern Dairy Area. The land was all tillable except that used for the farmstead. The annual livestock program included 15 to 20 sows and pigs, 15 to 20 dairy cows and 100 to 150 chickens. (The poultry enterprise was discontinued in December, 1950.) The total connected electrical load was 17.55 kilowatts on December 31, 1951. The family was comprised of two adults, two boys and one girl. This was the third farm selected to take part in the program.

Clayton County-Selected July 14, 1950. This 305-acre farm was in the Northeast Dairy Area. One-hundred-sixty-nine acres were tillable and 136 acres were in permanent pasture, timber and farmstead. The annual livestock program included 35 sows and pigs, 20 dairy cows and 200 chickens. The total connected electrical load was 45.07 kilowatts on December 31, 1951. The family was comprised of two adults, one boy and two girls. This was the eleventh farm selected to take part in the program.

Dickinson County-Selected June 5, 1950. This 320-acre farm was located in the Cash Grain Area. Two hundred-sixty acres were tillable with 54 acres in permanent pasture and farmstead. The annual livestock program included 30 to 40 sows and pigs, 40 to 95 feeder cattle and 125 chickens. The total electrical load was 29.32 kilowatts on December 31, 1951. The family was comprised of two adults and one son. Another son and family resided in a separate home on the farm. This was the ninth farm to be selected to take part in the program.

Jasper County-Selected April 28, 1948. This 160-acre farm was located in the Eastern Livestock Area. One hundred acres were tillable with 60 acres in permanent pasture and farmstead. The annual livestock program included 15 sows and pigs, 10 purebred Angus cows, 5 to 6 dairy cows and 500 chickens. The total connected electrical load was 20.03 kilowatts on August 1, 1949, when the program activity on this farm was discontinued. The family was comprised of two adults and one son. This was the fourth farm to be selected to take part in the program.

Marshall County-Selected May 9, 1950. This 375-acre farm was located in the Eastern Livestock Area. Three-hundred-six acres were tillable with 69 acres in permanent pasture and farmstead. The annual livestock program included 40 sows and pigs, 80 feeder cattle, 50 purebred Hereford cows and 150 chickens. (The poultry enterprise was discontinued February, 1951.) The total connected electrical load was 69.42 kilowatts on December 31, 1951. The family was comprised of two adults, one boy and two girls. This was the ninth farm to be selected to take part in the program.

Page County-Selected June 27, 1950. This 200-acre farm was located in the Western Livestock Area. This was the Soil Conservation Experimental Farm and many of the 175 tillable acres were in test plots. The annual livestock program included 65 feeder cattle and 50 to 100 chickens. The total connected load was 53.90 kilowatts on December 31, 1951. The family was comprised of two adults living on the farm. This was the tenth farm to be selected to take part in the program.

Warren County-Selected June 25, 1949. This 178-acre farm was located in the Southern Pasture Area. Fifty acres were tillable, 78 acres were in timber and 50 acres were in permanent pasture and farmstead. The annual livestock program included 60 to 75 hogs, 15 dairy cows and 100 chickens. The total connected load was 19.97 kilowatts on July 1, 1951 when the program was discontinued on this farm. The family was comprised of two adults, two boys and one girl. This was the fifth farm selected to take part in the program.

Washington County-Selected December 5, 1947. This 160-acre farm was located in the Eastern Livestock Area. The land was all tillable except that used for the farmstead. The livestock program included 600 hogs, 2 dairy cows and 400 chickens. The total connected electrical load was 30.20 kilowatts on December 31, 1951. The family was comprised of two adults, one boy and one girl. This was the second farm to be selected to take part in the program.

Webster County-Selected October 31, 1947. This 120-acre farm was located in the Cash Grain Area. The land was all tillable except that used for the farmstead. The livestock program included 10 sows and pigs, 10 to 20 beef cows and 300 chickens. The total connected electrical load was 34.96 kilowatts on December 31, 1951. The family was composed of two adults, one boy and two girls. This was the first farm selected to take part in the program.

Woodbury County-Selected July 7, 1949. This 120-acre farm was located in the Western Livestock Area. The Missouri River bottom land was all tillable except the upland farmstead. The annual livestock program included 80 sows and pigs, 5 to 7 feeder cattle and 8 to 12 dairy cows. The dairy enterprise was discontinued January, 1951. The total connected electrical load was 42.08 kilowatts on December 31, 1951. The family was comprised of two adults and one boy. This was the seventh farm to be selected to take part in the program.

MAJOR FARM PROBLEMS

There were some problems which applied to all the farms. Some of these were as follows:

Rewiring: Of the 11 farms which cooperated in the demonstration farm program, seven were found deficient in adequacy of their wiring systems according to recommended standards. Five were rewired and two farms had supplies on hand for rewiring or were in the process of installing a partially rewired system. Transformer relocations, installation of distribution poles, increased wire size plus some building rewiring usually was necessary on the farms where major items of electrical equipment were added.

Water Systems: Various stages of complete pressure water systems existed on all 11 participating farms prior to their selection for inclusion in the program. Several were expanded as a result of labor saving studies on the farm. General modernization including new piping layouts, pumping equipment and sanitation control was in the process of being accomplished or was planned for the remaining farms.

Building and Remodeling: Major structural modifications had been completed on 5 farms and were contemplated on two farms. Minor structural changes were made on all farms. On one farm all buildings were remodeled or rebuilt on a new farmstead site over a period of 13 years to comply with a master plan. The most extensive remodeling has taken place in the farm home--usually kitchen and utility room modernization.



Fig. 2. A discussion on home remodeling at a public demonstration on the Audubon County farm.

PUBLICIZING RESULTS OF STUDIES

The two primary media for getting information to the rural electricity user was through public demonstrations and publications. Supplementing these were innumerable press releases, radio interviews and talks, television broadcasts and a sound-color movie.

Result Demonstrations: After approximately 1 year of electrical use and related data were collected on each of the farms, public demonstrations were held to present to farm families and others in those areas information on efficient and effective use of electricity. A few of the demonstrations were held for specific groups. All are listed as follows:

<u>Date</u>	<u>Location</u>	<u>Attendance</u>
November 12, 1948	Washington County	200
November 19, 1948	Webster County	300
October 14, 1949	Black Hawk County	100*
October 17, 1949	Webster County	25 *
October 21, 1949	Washington County	95 *
November 15, 1949	Black Hawk County	300
September 26, 1950	Audubon County	450
October 12, 1950	Woodbury County	350
September 25, 1951	Dickinson County	100
October 4, 1951	Clayton County	350
October 11, 1951	Marshall County	250
October 25, 1951	Page County	200

*Indicates special demonstration for power supplier and extension personnel, vocational agricultural instructors and other educational groups.

In addition to formally presented demonstrations, individuals and groups have visited the farms to observe electrical equipment used with respect to work saving methods in the home and on the farm.

Publications: Most of the material released for publication on demonstration farm results has been in popularized writing form through Iowa Farm Science. Releases in this manner provided a source of information otherwise unavailable to most rural electricity users. Publication has been based upon farm need and availability of such information through this program.

Those publications released and the number of article reprints distributed are as follows:

DeForest and Beaty. Wire Your Farm for Better Service. Iowa Agricultural Extension Service pamphlet 144. September, 1949. 55,250 reprints.

Beaty and Johnson. Corn Elevation. Iowa Farm Science, FS-292, Vol. 4, No. 4 October, 1949. 11,200 reprints.

DeForest and Beaty. Kilowatts Cut Poultry Chores. Iowa Farm Science, FS-297, Vol. 4, No. 6 December 1949. 1,650 reprints.

Johnson and Beaty. How to Save More Pigs. Iowa Farm Science, FS-301, Vol. 4, No. 7 January, 1950. 2,850 reprints.

DeForest. Better Chick Brooding With Electricity. Iowa Farm Science, FS-316, Vol. 4, No. 10 April 1950. 1,500 reprints.

Johnson. Which Water Pump for Your Farm. Iowa Farm Science, FS-326, Vol. 5, No. 1 July 1950. 11,400 copies.

Johnson. Water Your Stock Automatically. Iowa Farm Science, FS-339, Vol. 5, No. 4 October 1950. 900 copies.

Beaty. Buying a Home Freezer. Iowa Farm Science, FS-341, Vol. 5, No. 4 October 1950. 400 copies.

In addition a number of articles based upon the demonstration farms have appeared in leading national magazines. Included were the following:

Wolf. Making Electricity More Efficient. Cappers Farmer, September 1949.

DeForest and Beaty. Wires Are Like Water Pipes. Country Gentleman, February, 1950.

Johnson. Good Water Supply Depends Upon Choosing Right Kind of Pump. National Livestock Producer, September, 1950.

DETAILED RESULTS OF RESEARCH

In this section electrical energy consumption data are presented which were collected over a period of 1 or more years. The data presented include total farm energy consumption and a breakdown showing consumption in the home, on the farmstead and the energy consumption for the different pieces of electrical equipment used on the farms. Except for pieces of equipment which were used only on one farm, the energy consumption data are summarized by a table or graph. A paragraph accompanies each table or graph giving a short statement of results and the conditions affecting the results. Tables showing the complete monthly electrical energy consumption for each item discussed are included in the appendix.

Electrical History of Farms. The annual electrical energy consumptions for some of the rural electrification demonstration farms during a 10-year period are shown by the graphs of fig. 3. (Such a graph for the Jasper County farm was not included because no annual consumption data were available for the years 1949, 1950 and 1951.) All graphs show a marked increase in electrical energy consumption during the period plotted.

All rural electrification demonstration farms consumed more than the state average annual consumption of 3,380 kilowatt-hours per farm for the year 1951.

The year that each of the farms first obtained electrical service is shown in Table A-1 of the appendix.

Monthly Electrical Energy Consumption. The electrical energy consumption by the month is shown by the graphs of fig. 4 for each of the rural electrification demonstration farms for a 5-year period 1947 through 1951, except for instances in which such monthly consumption data were not available. During the periods in which the farms were cooperating in the program, the total monthly electrical energy consumption is divided into energy used in the home and energy used about the farmstead. The total energy consumption for other months was found by referring to records of the power suppliers, but it was not possible to sub-divide these totals. They are represented by the bars shown on fig. 4 with no internal shading.

Shown on the graph for each farm in fig. 4 is the percentage of the total electrical energy consumption which was used in the farm home during the period the farm was in the program. Only the Black Hawk County, Webster County and Woodbury County farms used more electrical energy about the farmstead than was used in the home.

Electrical Energy Consumption in the Farm Home. The electrical energy consumed in the farm home was fairly constant from month to month, although reference to fig. 4 will show a slight seasonal variation for most of the farms. For these farms, electrical energy consumption tended to be higher in winter months than it was during summer months. This can be accounted for by the lighting and home heating loads.

In many instances it is possible to detect the month of installation of major appliances by referring to fig. 4. For instance, a water heater was installed on the Clayton County farm during August, 1951; a water heater was installed on the Page County farm during March, 1951; a home freezer was installed on the Washington County farm during April, 1949; an electric range was installed on the Webster County farm during November, 1949; a home freezer was installed on the Woodbury County farm during December, 1949.

Dishwasher. The only operational data about a dishwasher were obtained on the Marshall County farm during 4 months of 1950 and 12 months of 1951. During these 16 months of operation, 49 kilowatt-hours of electrical energy were used. This would be an average of about 3.1 kilowatt-hours a month.

Freezers. The monthly consumption for eight home freezers is shown in fig. 6. The size and the location of each freezer is also indicated. These two factors had an important influence on energy consumption. The basement was the most common location for home freezers. First floor locations such as those at Warren and Washington counties showed definite peaks in mid-summer. The enclosed porch-location of the freezer in Page County also showed a definite mid-summer peak. Energy consumption was more uniform for basement locations but summer peaks could be detected. Other peaks which occurred at irregular intervals can be attributed to reloading of the units.

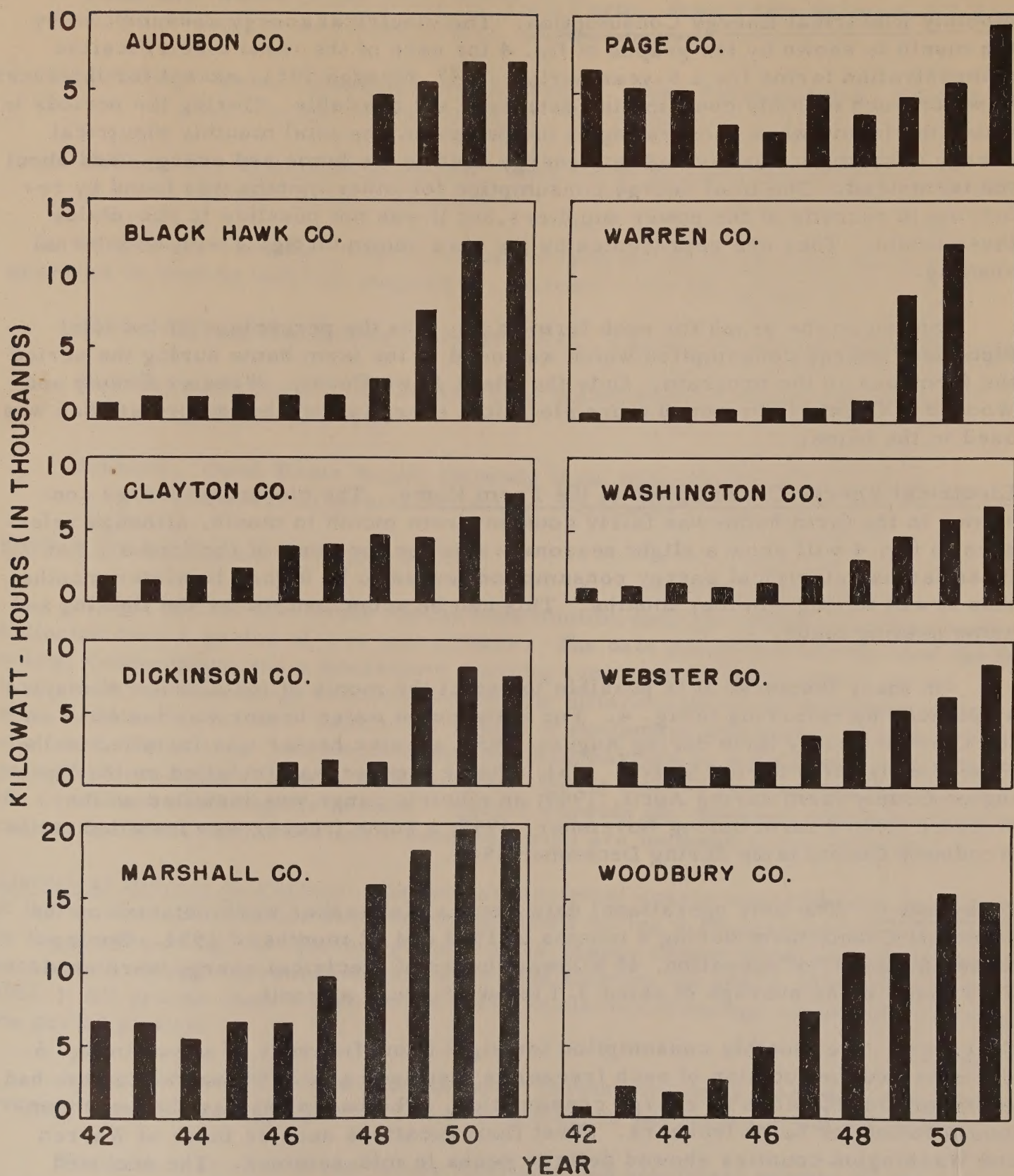


FIG. 3 ANNUAL ELECTRICAL ENERGY CONSUMPTION OF RURAL ELECTRIFICATION DEMONSTRATION FARMS.

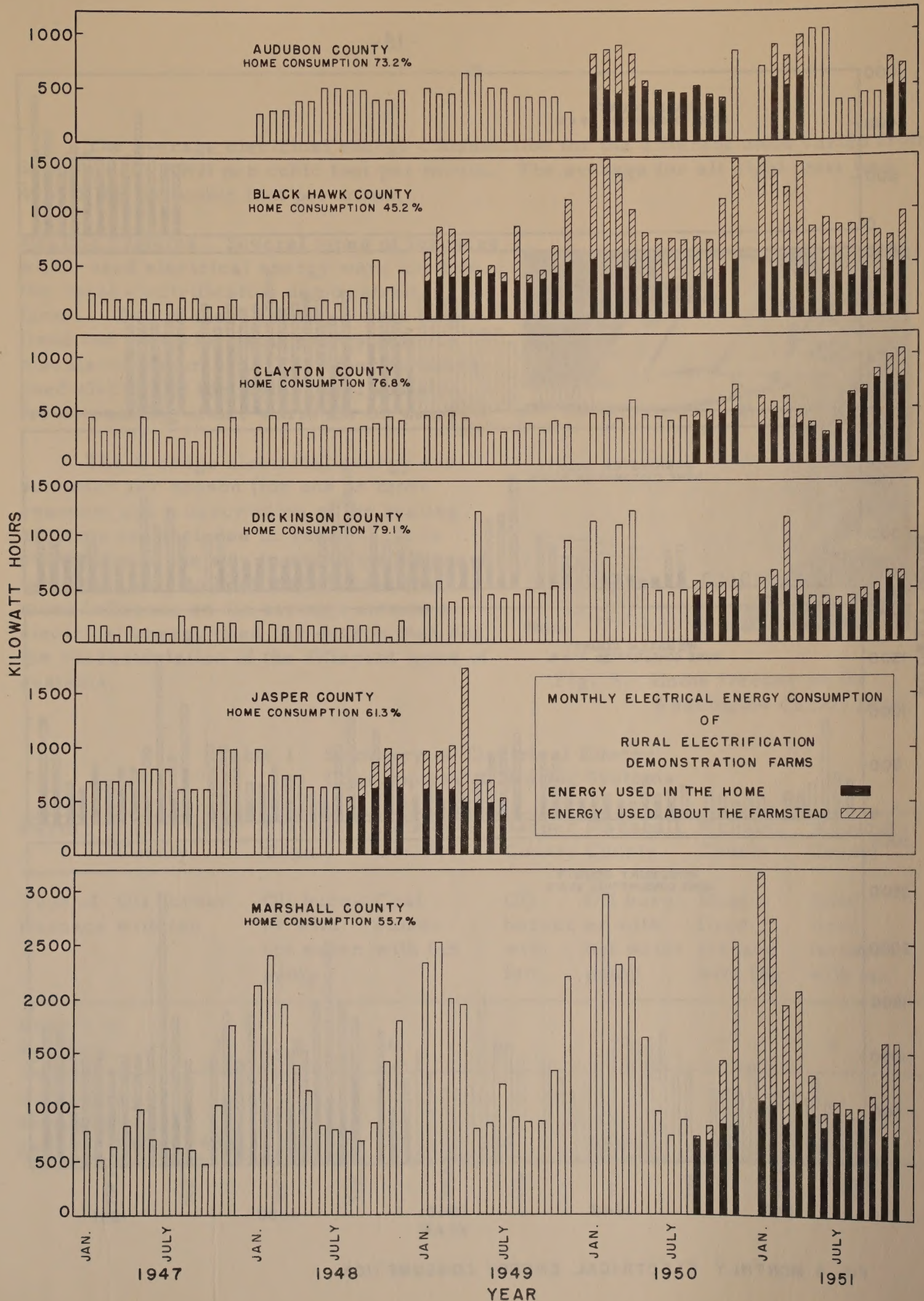


FIG. 4. MONTHLY ELECTRICAL ENERGY CONSUMPTION

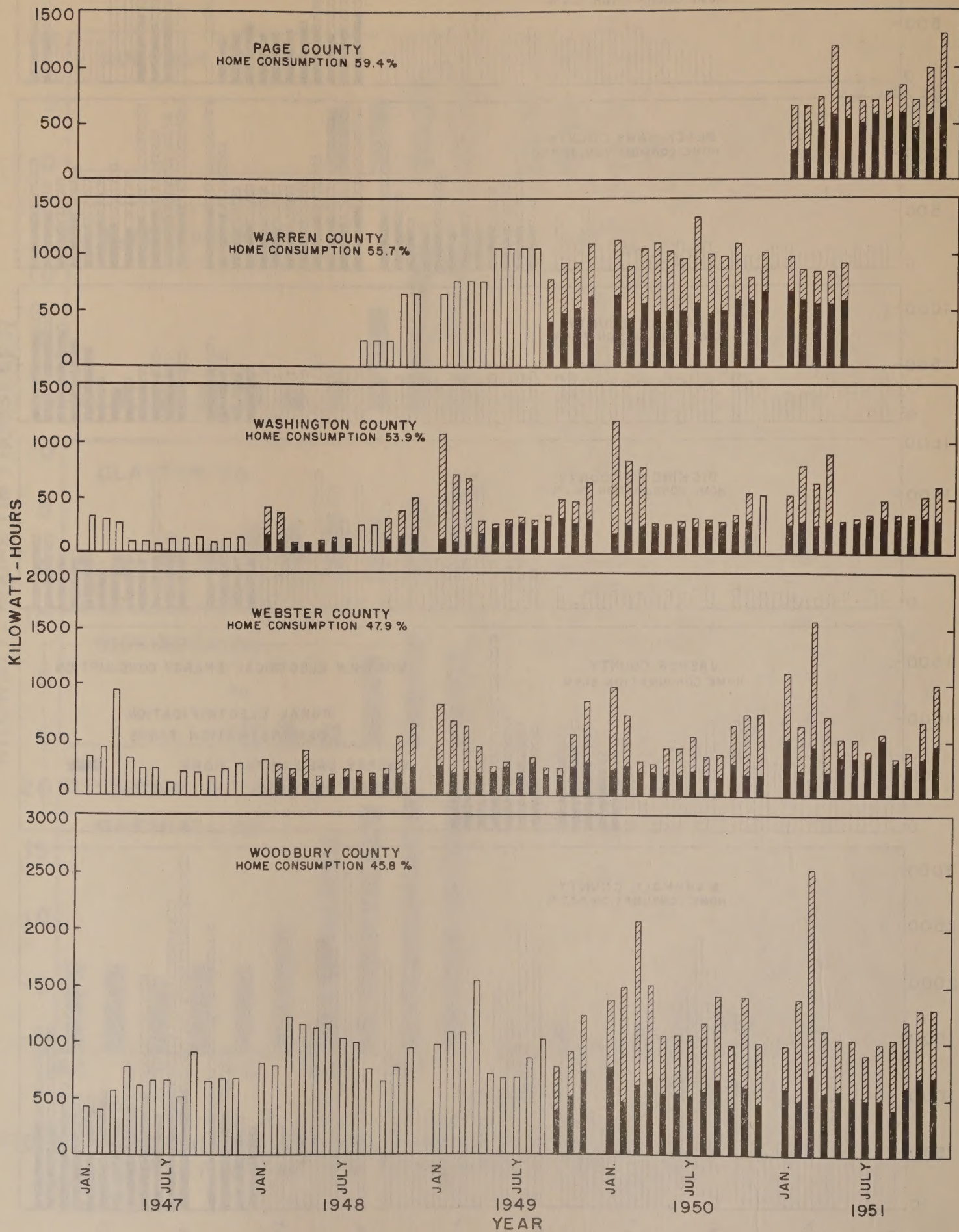


FIG. 4 MONTHLY ELECTRICAL ENERGY CONSUMPTION.

The average electrical energy consumption for the different units varied from 3.56 to 6.27 KWH per cubic foot per month. The average for all eight units was 4.67 KWH per cubic foot per month.

Heating Systems. Several types of furnaces which used electrical energy were used on the rural electrification demonstration farms. Two of these furnaces were hand-fired and used electrical energy only for circulating warm air. The other furnaces used electricity for feeding fuel and also for circulating either warm air or water.

The average electrical energy consumption per season (for one or more seasons) and a description of the heating systems are included in Table 1. It is probable that the way in which the different families chose to heat their homes had more influence on the average amount of electrical energy used per season than did the characteristics of the different types of systems.

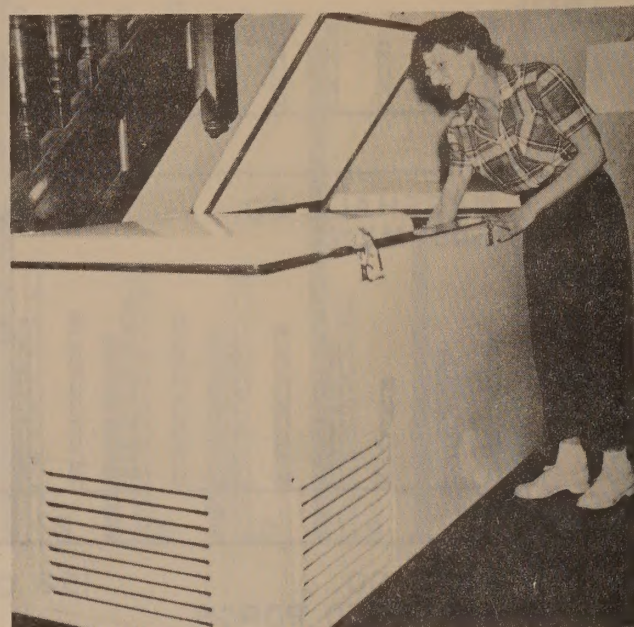


Fig. 5. Home freezer on the Washington County farm.

Table 1. Summary of Electrical Energy Consumption of Heating Systems

Farm	Black Hawk County	Clayton County	Dickinson County	Jasper County	Marshall County	Webster County	Woodbury County
Type of Furnace	Oil burner with fan	Oil burn- er with hot water pump	Coal stoker with fan	Oil burner with fan	Oil burn- er with hot water pump	Hand- fired furnace with fan	Hand- fired furnace with fan
Rooms in dwelling	7	8	6	6	7	7	7
Av. energy used per season, KWH	590	305	313	388	1092	162	159

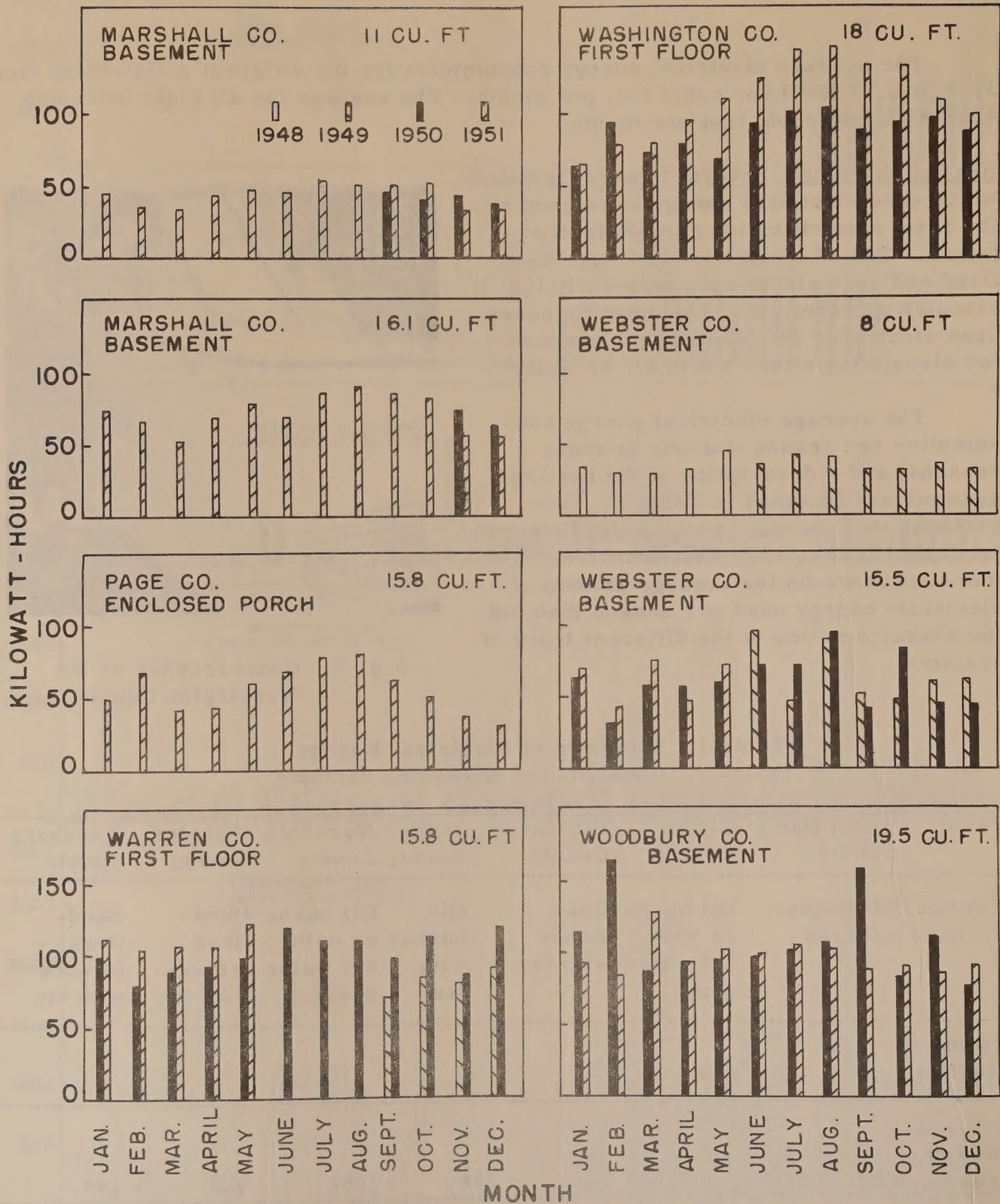


FIG. 6 ENERGY CONSUMPTION OF HOME FREEZERS.

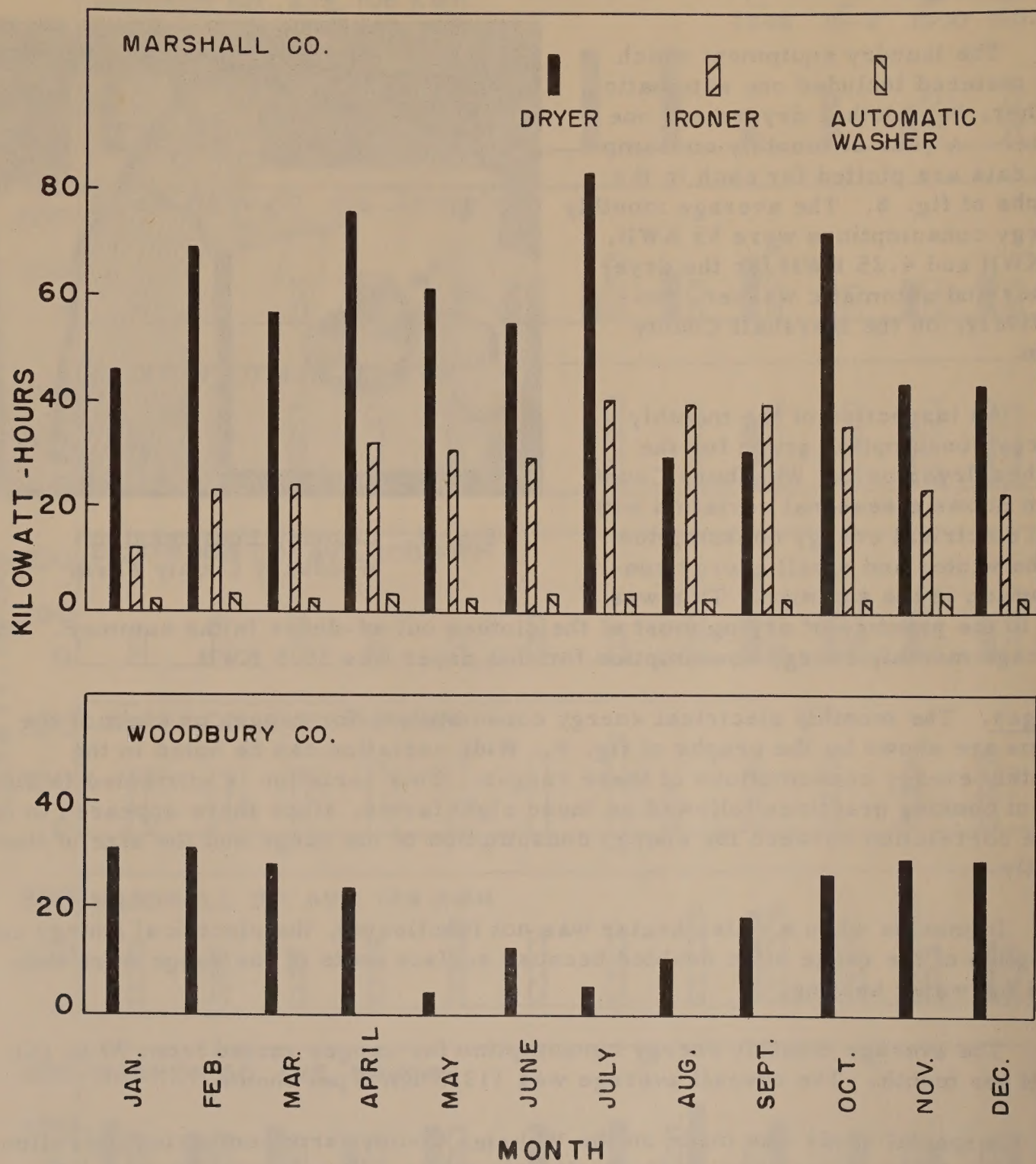


FIG. 8 ENERGY CONSUMPTION OF LAUNDRY EQUIPMENT.

The laundry equipment which was metered included one automatic washer, two clothes dryers and one ironer. A year of monthly consumption data are plotted for each in the graphs of fig. 8. The average monthly energy consumptions were 55 KWH, 29 KWH and 4.25 KWH for the dryer, ironer and automatic washer, respectively, on the Marshall County farm.



Fig. 7. Laundry Equipment on Woodbury County Farm

An inspection of the monthly energy consumption graph for the clothes dryer on the Woodbury County farm shows a seasonal variation with high electrical energy consumption in the winter and small energy consumption in the summer. This was due to the practice of drying most of the clothes out-of-doors in the summer. The average monthly energy consumption for this dryer was 20.5 KWH.

Ranges. The monthly electrical energy consumptions for ranges on eight of the farms are shown by the graphs of fig. 9. Wide variation can be noted in the monthly energy consumptions of these ranges. This variation is attributed to different cooking practices followed on these eight farms, since there appeared to be little correlation between the energy consumption of the range and the size of the family.

In months when a water heater was not functioning, the electrical energy consumption of the range often doubled because surface units of the range were then used for water heating.

The average monthly energy consumption for ranges varied from 79 to 161 KWH per month. The overall average was 113.3 KWH per month.

A special study was made on the Webster County farm comparing operation of a liquid petroleum gas range with an electric range. (See Special Studies.)

Refrigerators. The monthly electrical energy consumptions for refrigerators are shown by the graphs of fig. 10. For all refrigerators on demonstration farms the average energy consumption was 31.1 KWH per month with the size of units varying from 6 to 10.7 cubic feet. A seasonal peak energy consumption during the months of July and August can be noted for most of these refrigerators.

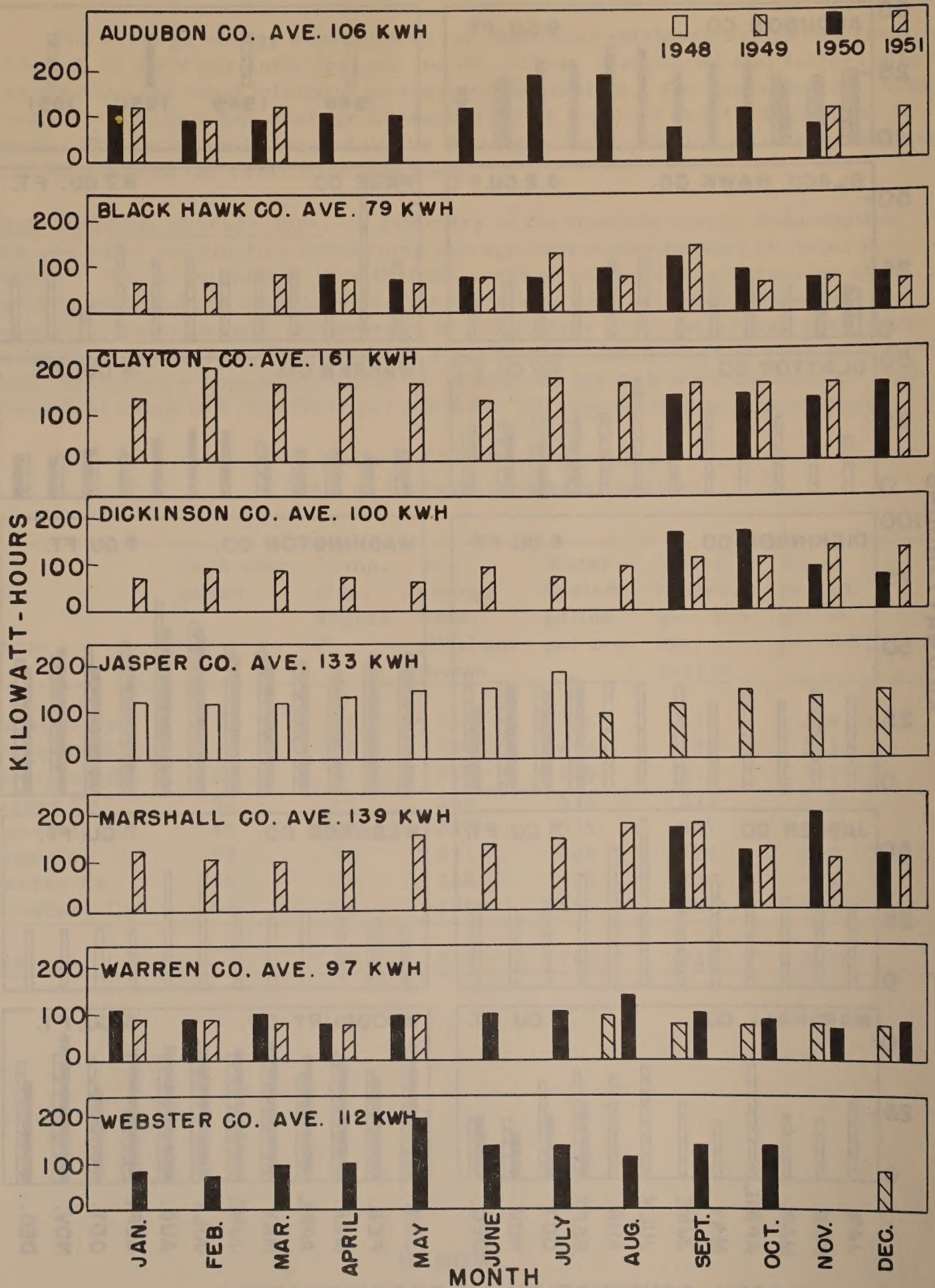


FIG. 9 ENERGY CONSUMPTION OF ELECTRIC RANGES.

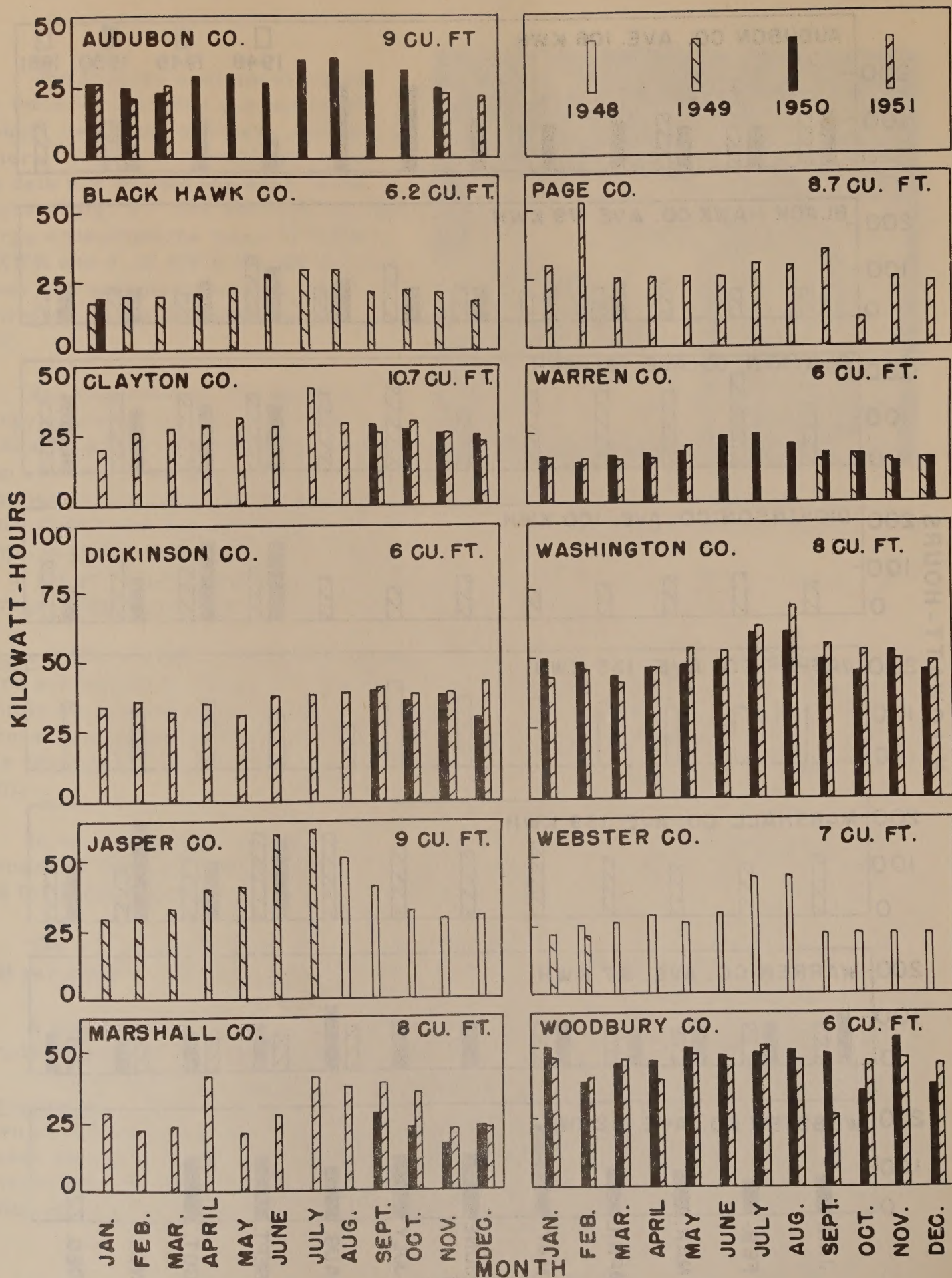


FIG. 10 ENERGY CONSUMPTION OF REFRIGERATORS.

The average energy consumption for individual refrigerators varied from 2.58 to 7.32 KWH per cubic foot per month. Thus, it appeared that factors other than size had the most influence on energy consumption. For instance, the three 6-cubic foot models had average consumptions of 17, 36.8 and 43.8 KWH per month. The latter unit, located on the Woodbury County farm, was recessed in a wall niche where the ventilation was poor.

Water Heaters, Storage-type. A summary of the monthly energy consumption data and other information concerning storage-type water heaters is listed in Table 2. It is of interest to note that the average energy consumption for all water heaters did not vary greatly, but there was wide variation in the average amounts of water heated. An average of 225 gallons of hot water was used each month for each person living on these eight farms. An average of 3.05 gallons of water was given a temperature rise of 94 degrees for each KWH consumed. The theoretical value is 4.1 gallons per KWH for 100 degree rise in temperature.

Table 2. Summary of Monthly Operational
Data on Storage-type water heaters

Farm	Tank size, gallon	Temp. rise, degree F	Av. energy used, KWH per month	Water heated, gallon per mo.	Water heated, gal. per mo. per person	Water heated, gallon per KWH
Audubon Co.	40	96	250	706	118	2.8
Black Hawk Co.	52	94	237	492	123	2.1
Dickinson Co.	52	--	211	655	218	3.1
Jasper Co.	52	--	256	636	212	2.5
Marshall Co.	40	102	248	935	187	3.8
Page Co.	52	96	311	848	424	2.7
Warren Co.	30	78	268	1178	236	4.4
Woodbury Co.	52	96	286	861	287	3.0
Average		94	258	789	225	3.05

Electrical Energy Consumption About the Farmstead. In contrast to electrical energy consumption in the farm home, the energy consumption about the farmstead varied widely from month to month. During the period when the farms were in the program, it was found that from 21 to 55 percent of the total amounts of electrical energy consumed were used about the farmstead.

Reference to the graphs of fig. 4 will show that winter peaks are very much in evidence for all farms. These winter peaks are attributed to energy consumption of stock waterers and brooding equipment.

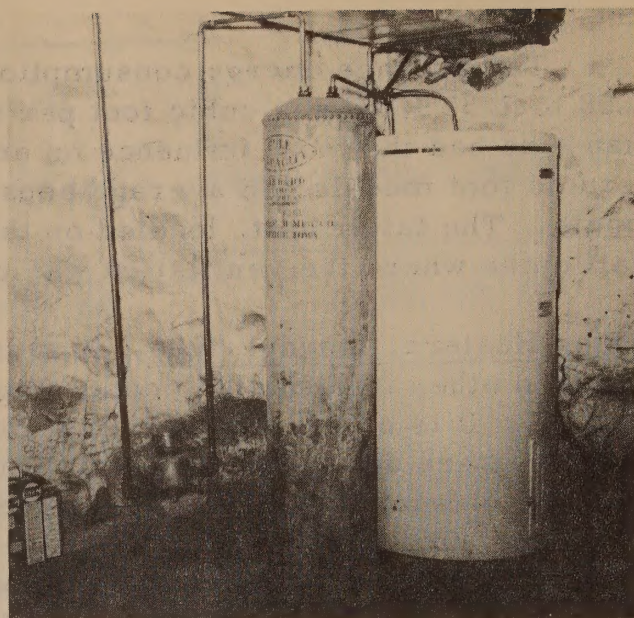


Fig. 11. Storage-type water heater with tempering tank on the Black Hawk County farm

Energy Losses in Farmstead Wiring. The graphs of fig. 12 show monthly energy losses attributed to farmstead wiring. The losses were computed by summing the energy used at all locations about a farmstead and subtracting this total from the amount of energy delivered to the farm each month as indicated by the main meter. The losses are shown as percentages of the total amount of electrical energy delivered to the farms.

Adequate wiring is indicated only if the energy losses are consistently low.

Average energy losses in farmstead wiring ranged from a high of 6.2 percent per month for the Audubon County farm to a low of 1.6 percent for the Black Hawk County farm, which had been rewired.

Grain Elevation. A 3-horsepower motor was used to furnish power to an indoor bucket-type grain elevator on the Washington County farm. A 5-horsepower motor was used to furnish power for the elevator on the Marshall County farm.

During 1950 and 1951, approximately 27,000 bushels of corn were elevated on the Washington County farm with an energy requirement of 104 KWH. This was an energy consumption of 2.6 KWH per 1,000 bushels of corn elevated.

During the fall of 1950, 5,000 bushels of ear corn were elevated on the Marshall County farm. An undetermined amount of corn was rolled with the same motor and a portion of the energy consumed was used to overcome friction losses in the gearing and line shaft. A total of 52 KWH were used.

Lights, Poultry House. Poultry house lighting data were obtained on the Clayton County, Washington County and Webster County farms. Energy consumption of

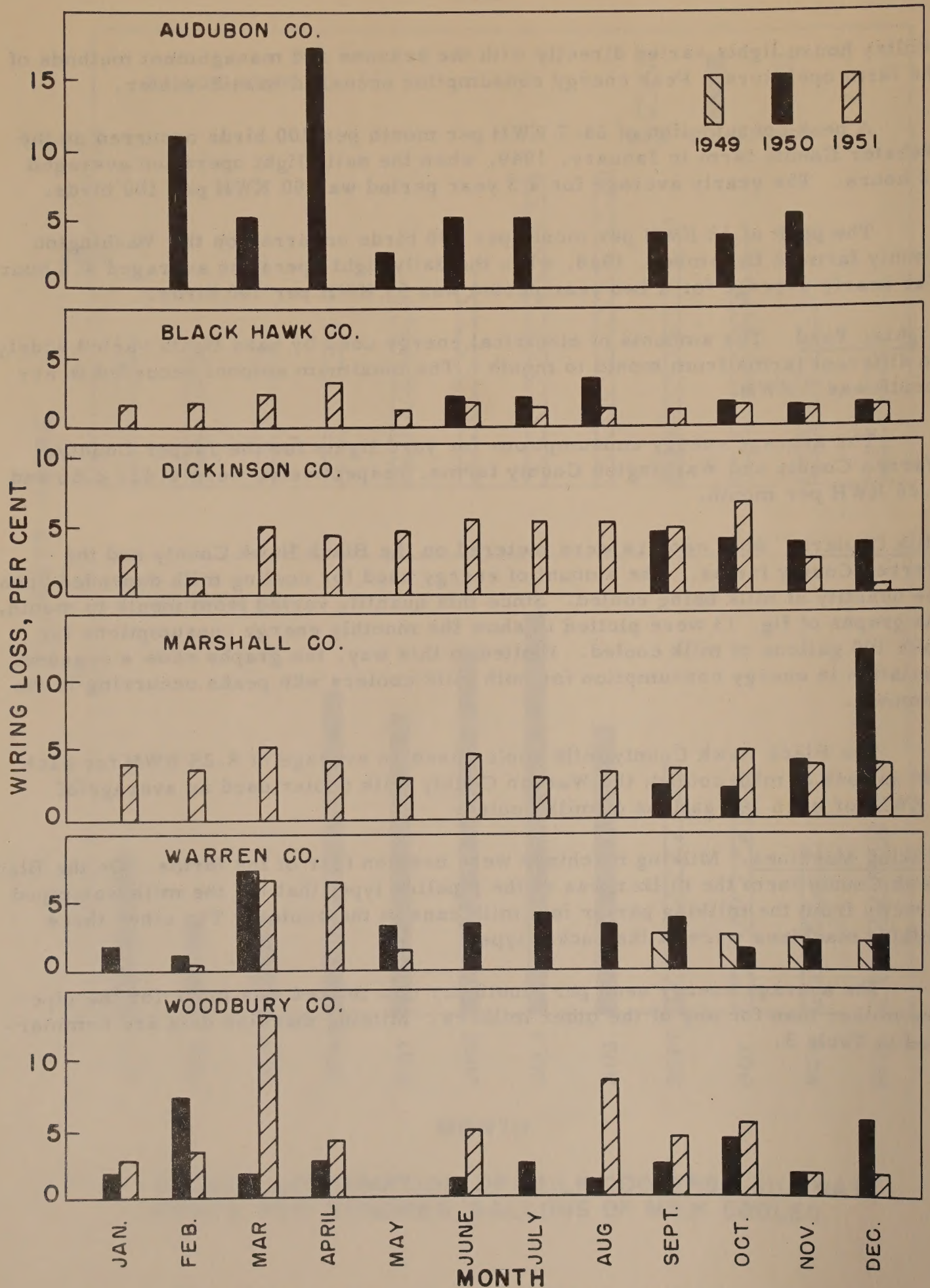


FIG. 12 ENERGY LOSSES IN FARMSTEAD WIRING.

poultry house lights varied directly with the seasons and management methods of the farm operators. Peak energy consumption occurred in mid-winter.

A peak consumption of 24.7 KWH per month per 100 birds occurred on the Webster County farm in January, 1949, when the daily light operation averaged 12 hours. The yearly average for a 3 year period was 90 KWH per 100 birds.

The peak of 12 KWH per month per 100 birds occurred on the Washington County farm in December, 1948, when the daily light operation averaged 4.6 hours. The yearly average for a two year period was 53 KWH per 100 birds.

Lights, Yard. The amounts of electrical energy used by yard lights varied widely on different farms from month to month. The maximum amount recorded in any month was 7 KWH.

The average energy consumptions for yard lights for the Jasper County, Warren County and Washington County farms, respectively, were 4.42, 2.56 and 1.26 KWH per month.

Milk Coolers. Milk coolers were metered on the Black Hawk County and the Warren County farms. The amount of energy used for cooling milk depended upon the quantity of milk being cooled. Since this quantity varied from month to month, the graphs of fig. 13 were plotted to show the monthly energy consumptions for each 100 gallons of milk cooled. Plotted in this way, the graphs show a seasonal variation in energy consumption for both milk coolers with peaks occurring in the summer.

The Black Hawk County milk cooler used an average of 8.25 KWH for each 100 gallons of milk cooled; the Warren County milk cooler used an average of 9 KWH for each 100 gallons of milk cooled.

Milking Machines. Milking machines were used on four of the farms. On the Black Hawk County farm the milker was of the pipeline type; that is, the milk was piped directly from the milking parlor into milk cans in the cooler. The other three milking machines were of the bucket type.

The average energy used per month per cow milked was more for the pipeline milker than for any of the other milkers. Milking machine data are summarized in Table 3.

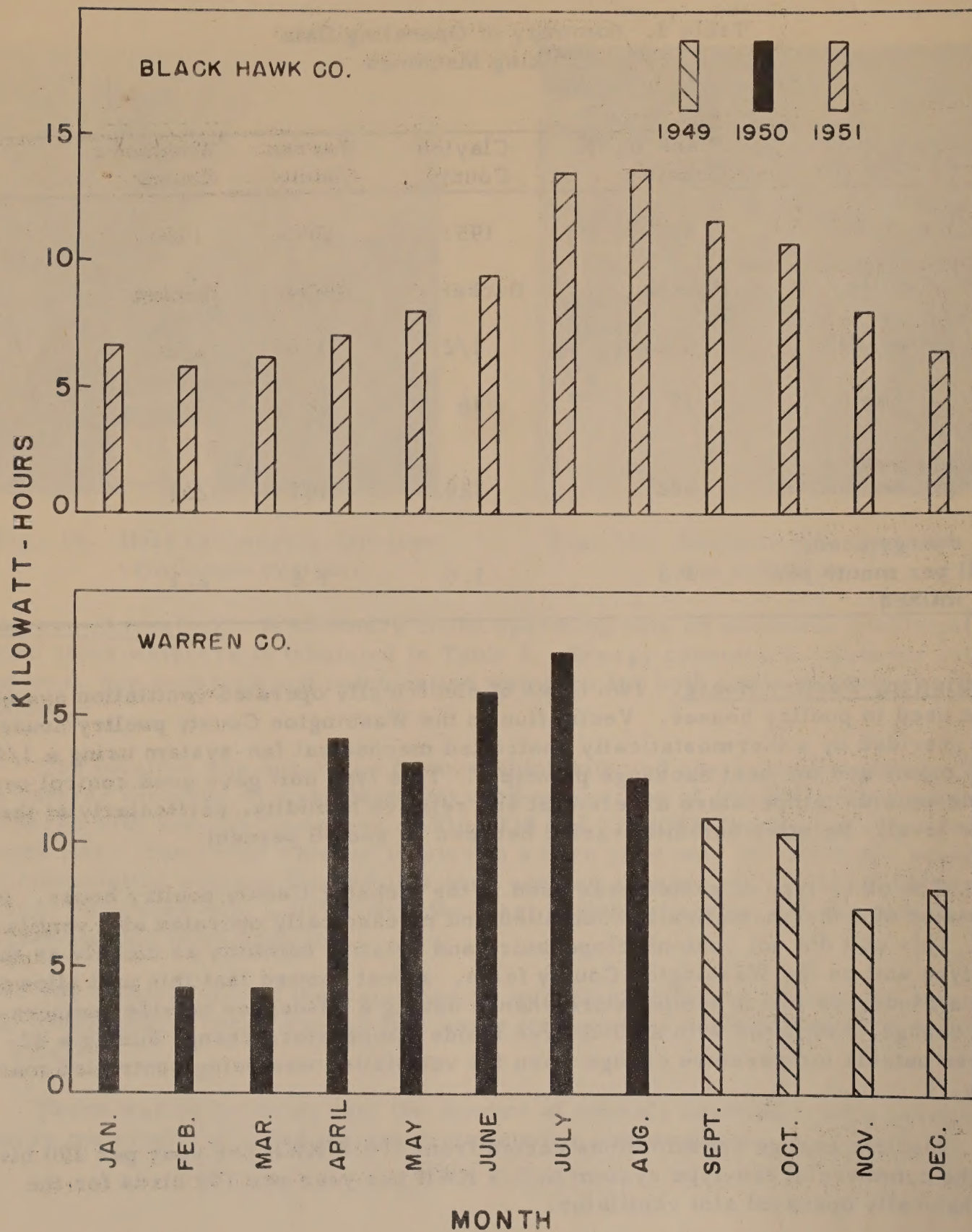


FIG. 13 ENERGY CONSUMPTION OF MILK COOLERS, KILOWATT-HOURS PER HUNDRED GALLONS OF MILK COOLED.

Table 3. Summary of Operating Data
on Milking Machines

Farm	Black Hawk County	Clayton County	Warren County	Woodbury County
Year	1951	1951	1950	1950
Type of milker	Pipe line	Bucket	Bucket	Bucket
Motor size, HP	1/2	1/2	1/3	1/2
Av. No. cows milked	17	16	10	8
Energy used, KWH	682	329	197	201
Av. energy used, KWH per month per cow milked	3.3	1.6	1.6	2.1

Ventilation, Poultry House. Two types of electrically operated ventilation systems were used in poultry houses. Ventilation in the Washington County poultry house was provided by a thermostatically controlled mechanical fan-system using a 1/4 h.p. motor and the heat exchange principle. This type unit gave good control over inside-outside temperature differential and relative humidity, particularly at the roost level. Relative humidity varied between 75 and 90 percent.

The other type of system was used in the Webster County poultry house. It consisted of a thermostatically controlled and mechanically operated slot ventilator. This unit did not control temperature and relative humidity as closely as the fan-type unit on the Washington County farm. A test showed that this unit allowed only a 24-degree inside temperature change during a 58-degree outside temperature change, compared with a 30-degree inside temperature change during a 42-degree outside temperature change when the ventilation was being controlled manually.

Electric energy consumptions varied from 179.8 KWH per year per 100 birds for the commercial fan-type system to 7.9 KWH per year per 100 birds for the mechanically operated slot ventilator.



Fig. 14. Heat exchanger, fan-type ventilation system.

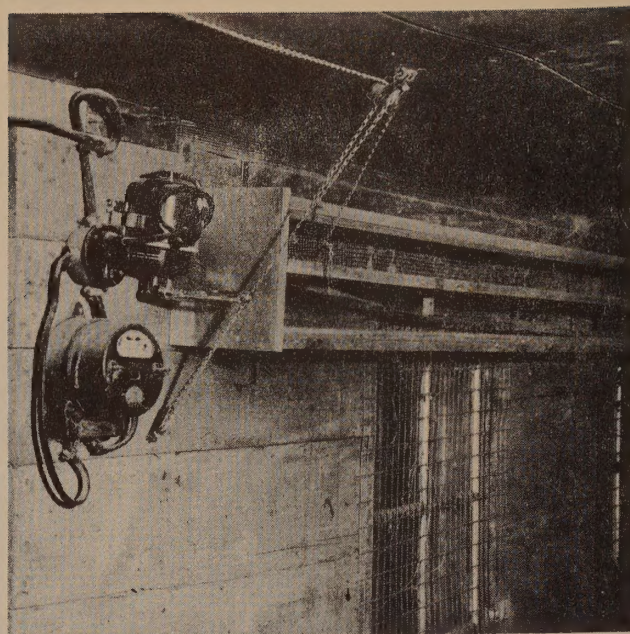


Fig. 15. Mechanically operated slot ventilator.

Waterers, Livestock. A summary of the operating data on automatic electrically heated stock waterers is tabulated in Table 4. Energy consumption data for cattle waterers, hog waterers and combination waterers for both cattle and hogs were obtained.

The location was one of the factors which affected energy consumption. The hog waterer installed in a sheltered lot used an average of 170 KWH per season, compared with seasonal averages of 316, 330 and 338 KWH for hog waterers located in open lots. The cattle waterer located in a barn used only 106 KWH per season. The combination waterer located in a shed used an average of only 585 KWH per season, compared with 1,099 KWH, the least amount of energy for any combination waterer located in an open lot.

The temperature of the water had an important influence on energy consumption. Occasional checks showed that water temperature varied from 62°F in different waterers.

There was no evidence that the number of animals drinking from a particular waterer materially affected the electrical energy consumption.



Fig. 16. Combination cattle and hog waterer installed in a fence line to serve two lots.



Fig. 17. The hog waterer on the Black Hawk County farm

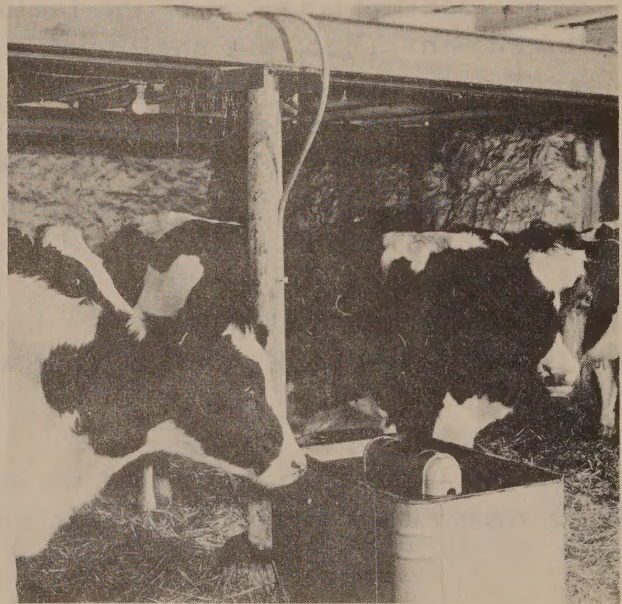


Fig. 18. The cattle waterer installed inside the barn on the Black Hawk County farm

Table 4. Summary of Operating Data on Electrically Heated Stock Waterers

Farm	Waterer type	Location	Energy used, kilowatt-hours			
			1949	1950	1951	Av.
Audubon Co.	Comb.	Shed		520	651	585
Black Hawk Co.	Hog	Open Lot		405	226	316
Black Hawk Co.	Cattle	Barn		106		106
Marshall Co.	Comb.	Open Lot			2598	2598
	N.E.					
Marshall Co.	Comb.	Open Lot			1099	1099
	S.E.					
Marshall Co.	Comb.	Open Lot			2493	2493
	N.W.					
Washington Co.	Hog #1	Shelter Lot	142	167	221	170
Washington Co.	Hog #2	Open Lot	259	329	401	330
Webster Co.	Comb.	Open Lot	1493	1850	2288	1744
Woodbury Co.	Hog	Open Lot		377	300	338

Water Heaters, Dairy. Two types of dairy water heaters were used. These were the storage-type on the Black Hawk County farm and the pour-in-type used on the Warren County and Woodbury County farms. The quantity of water heated by the dairy water heater on the Woodbury County farm was not measured. With reference to Table 5 in which the data are summarized, it can be seen that the storage type water heater was more efficient.

Water Systems, Pressure. Tabulated in Table 6 are data pertaining to pressure water systems on Rural Electrification Demonstration Farms. The approximate pumping heads shown in this table were derived by taking into account the depth of the well and assuming an average tank pressure of 30 p.s.i.

The range of energy requirements for deep-well pump motors was from 2.42 to 2.78 KWH per 1,000 gallons of water pumped. The average was 2.55 KWH per 1,000 gallons pumped.

The range of energy requirements for shallow-well pump motors was from 1.56 to 2.16 KWH per 1,000 gallons pumped. The average was 1.94 KWH per 1,000 gallons pumped. (The shallow-well centrifugal pump is not included.)

Table 5. Summary of Operating Data
on Dairy Water Heaters

Farm	Black Hawk County	Warren County	Woodbury County
Type	Storage	Pour-in	Pour-in
Tank size, gal.	20	17	15
Year	1951	1950	1950
Av. No. cows milked	17	10	9
Energy used, KWH	2240	2823	2080
Energy used, KWH per mo.	187	235	174
Water heated, gal.	7570	10281	
Water heated, gal. per mo.	630	855	
Water heated, gal. per mo. per cow	36.0	85.5	
Water heated, gal. per KWH	3.4	3.8	

No significant difference in electrical consumption for operation of jet vs. piston-type pumps could be drawn from these data.

Welders. Even though electric arc welders contributed greatly to the connected load, (7360 and 8510 watts, respectively, for the Clayton and Marshall county farms) Table 7 shows that these welders used but little energy during a year of operation. It can be noted that welders on both farms hit a peak of energy consumption during March. Field machinery was being overhauled on both farms during this month.

SPECIAL STUDIES

Range Comparison. A special study to compare two types of ranges was made on the Webster County Farm. One range burned L.P. gas and data concerning its operation were taken during a period of 11 months, from October, 1948 to September, 1949. The other, an electric range, was then installed and data concerning its operation were obtained from November, 1949 through October, 1950. These ranges are shown in figs. 20 and 21. Both were modern ranges of approximately the same retail value.

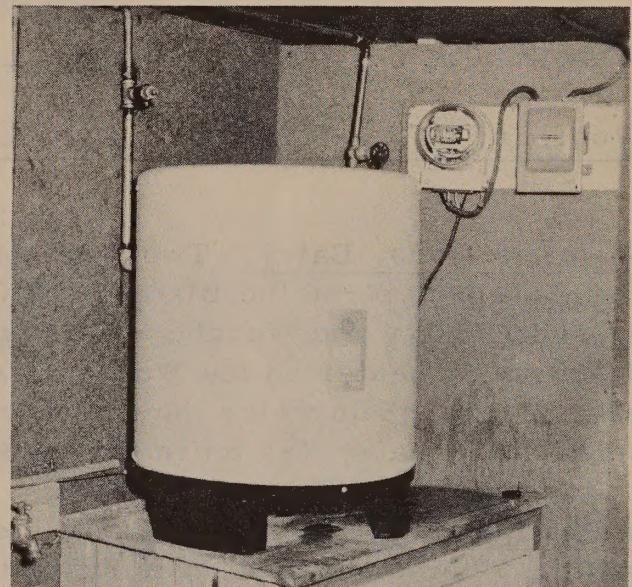


Fig. 19. Storage-type dairy
water heater on
Black Hawk Co. farm

Table 6. Summary of Water System Data

Farm	Type Pump	Approx. head, feet	Average quantity water pumped, gal. per mo.	Average energy used, KWH per mo.	Energy used, KWH per 1000 gal. pumped
Black Hawk County	Shallow-well piston	140	14750	35.7	2.42
Jasper County	Shallow-well piston	80	15506	24.3	1.56
Warren County	Shallow-well centrifugal	140	12692	104.5	8.24
Warren County	Shallow-well piston	140	9680	16.7	1.73
Webster County	Deep-well jet	105	8133	22.0	2.78
Woodbury County	Deep-well jet	130	18550	45.3	2.44
Woodbury County	Shallow-well jet	110	3465	8.1	2.32
Woodbury County	Shallow-well piston	80	1270	2.7	2.16

Table 7. Energy Consumption Data
on Electric Welders (KWH)

	J	F	M	A	M	J	J	A	S	O	N	D	1951 Total
Clayton Co.	0	1	24	8	2	1	3	3	1	0	2	0	45
Marshall Co.	1	2	20	8	2	3	3	3	2	0	7	6	61

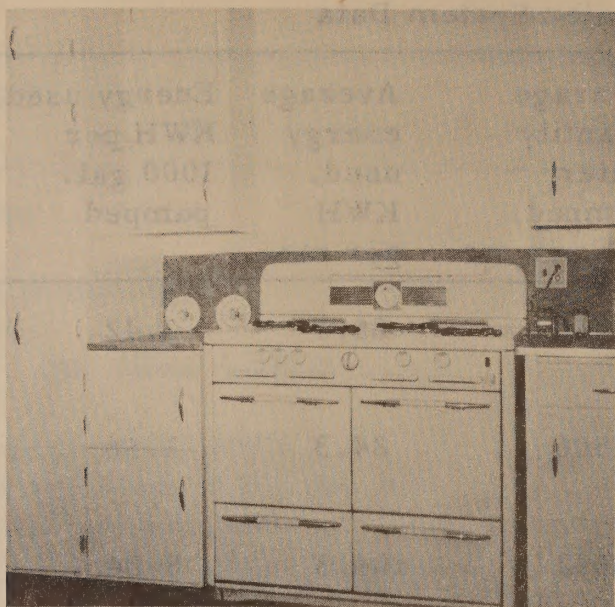


Fig. 20. Range using L.P. gas in Webster Co. kitchen



Fig. 21. Electric range in Webster Co. kitchen

It was found that the cost of cooking with L.P. gas averaged 8.4 cents a day, compared with an average of 7.2 cents a day for operating the electric range. The costs were based upon the prices which the family had to pay for these two commodities. Cost comparison alone does not give an entirely true picture because of differences in usage of the two ranges. For instance, both ranges were used occasionally for heating water when the water heater was not working. Records show that the gas range was used for this purpose on 14 days and the electric range was used for this purpose on 42 days.

Remodeling a Farm Kitchen. The kitchen on the Black Hawk County farm was remodeled following time and motion studies of the movements of the housewife about the old kitchen in preparing an evening meal. The new kitchen was arranged so that fewer steps would be necessary.

As part of the time and motion studies, the actual steps made by the housewife in preparing a meal were traced out by lengths of red yarn. It was found that the homemaker moved 1267 feet to prepare an evening meal in the old kitchen. A later time and motion study showed that the housewife moved 862 feet to prepare the same menu in the remodeled kitchen, a saving of 32 percent in distance moved. These time and motion studies were the basis for a motion picture in color entitled A Yarn About a Kitchen.

Table 8. Operation of L. P. Gas Range

Period per tank*	Days	lbs. gas per day	Break- fast	Lunch	Supper	Pies	Cakes	Doz. rolls	Doz. Cookies	Other
Oct. 4- Dec. 27	85	1.18	328	229	412	17	13	15	14	30 popcorn balls
Dec. 27- April 2	96	1.04	476	317	481	16	11	23	—	2 doz. doughnuts; 2 doz. muffins; 3 pans corn- bread; 6 gal. lard rendered
April 2- June 23	82	1.22	365	235	394	18	12	12	8	6 roast chickens; 14 days water heating
June 23- Sept. 5	74	1.35	312	258	332	12	8	7	13	154 quarts canning
4 tanks	337	1.20 av.	1535	1039	1619	63	44	57	35	

Av. meals per day, 12.4; av. cost per lb. gas, \$0.07; av. cost per day operation, \$0.084

* Each tank contained 100 lbs. of gas.

Table 9. Operation of Electric Range

1949-50	Days	KWH	KWH per day	Break- fast	Lunch	Supper	Pies	Cakes	Doz. rolls	Doz. cookies	Other
Nov.	30	78	2.60	124	67	140	6	6	3	4	2 roast ducks
Dec.	31	81	2.62	142	90	116	3	4	6	11	2 roast chickens
Jan.	31	82	2.65	128	74	136	6	4	7	—	
Feb.	28	73	2.60	106	76	130	9	5	5	5	
Mar.	31	96	3.10	—	—	—	—	—	—	—	
Apr.	30	95	3.16	150	101	162	5	8	4	3	
May	31	189	6.10	106	128	167	7	10	7	5	31 days water heating
June	30	128	4.20	154	147	157	4	7	10	15	9 days water heating
July	31	128	4.20	155	134	161	8	3	6	6	2 days water heating
Aug.	31	104	3.35	146	108	123	3	5	9	2	45 quarts canning
Sep.	30	129	4.30	150	98	145	9	8	8	4	2 doz. muffins; 332 quarts canning
Oct.	31	130	4.20	106	84	171	8	7	10	6	3 doz. muffins
	365	1313	3.60 av.	1517	1107	1608	67	67	72	61	

Av. meals per day, 12.5; av. cost per KWH, \$0.02; av. cost per day, \$0.072

The old and new kitchens are shown in figs. 22 and 23, respectively.



Fig. 22. A Farm Kitchen Before Remodeling



Fig. 23. A Remodeled Farm Kitchen

Brooding Cost Studies, Chick. Chick brooding costs for several Rural Electrification Demonstration farms are tabulated in Tables 10 and 11.

Electrical energy consumption of chick brooders varied from 55.5 to 303.8 KWH per 100 chicks. The low consumption resulted when a brooder was used to rated capacity.

Energy consumption of brooders on four farms averaged 153 KWH per 100 chicks.

During a 3-year test on the Washington County farm, the cost for brooding 100 chicks with electricity averaged \$3.52 a year, compared with an average cost of \$5.49 a year for oil-fired units. Under usual conditions the electrical brooder was considered safer and more dependable by the farm operator than was the oil-fired brooder.

Brooding Cost Studies, Pig. Comprehensive data were taken on two of the Rural Electrification Demonstration farms to obtain information about costs of pig brooding with electrical energy. Two different management practices were followed. On the Washington County Farm heat lamps were set up in portable buildings. This is illustrated in fig. 24. A lamp placed over a corner brooder in a permanent structure as illustrated in fig. 25 was used on the Woodbury County farm.

The results, tabulated in Table 12, show that the energy requirement per pig saved varied from 4.74 to 1.94 KWH. It should be noted that the costs shown for brooding on these farms were dependent upon different electrical rate structures.

Table 10. Operating Costs of Electrical Chick Brooders

Farm	Audubon : County :	Page : County :	Warren : County :	Washington County		
Year	1950	1951	1950	1949	1950	1951
Brooding period	March 15 to April 21	March 19 to April 26	April 10 to May 12	March 25 to May 1	March 19 to April 16	March 26 to April 26
House size, sq. ft.	120	192	96	144	144	144
Chicks housed	392	125	101	300	305	254
Chicks lost	24	4	9	0	0	2
Energy used, KWH	204	368	161	414	368	307
Energy used per hundred chicks, KWH	55.5	303.8	175	138	120.5	121.9
Rate per KWH	\$0.029	0.022	0.020	0.029	0.028	0.027
Total energy cost	5.92	8.23	3.22	12.00	10.12	8.14
Energy cost per hundred chicks	1.61	6.80	3.50	4.00	3.32	3.23

Table 11. Operating Costs of Oil-burning Chick Brooders on Washington County Farm

Year	Brooding period	House size, sq.ft.	Chicks housed	Chicks lost	Fuel used, gals.	Fuel cost per gal.	Total fuel cost	Fuel cost per 100 chicks
1949	March 25 to May 1	162	350	--	82	\$0.153	\$12.48	\$3.56
1950	March 19 to April 16	162	371	3	110	.153	16.80	4.56
1951	March 26 to April 26	162	280	4	135	.170	23.00	8.34

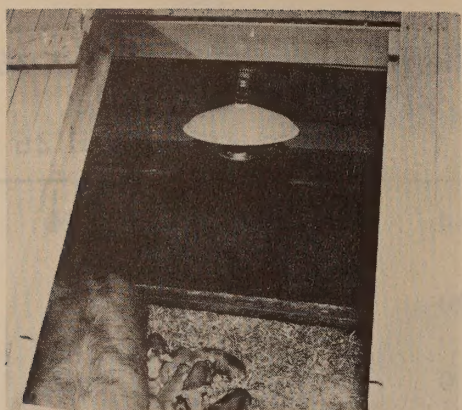


Fig. 24. Brooding Pigs in Portable Building



Fig. 25. Brooding Pigs in Permanent Structure

Time and Motion Studies of Choring Operations. Time and motion studies of chore operations were made on several of the Rural Electrification Demonstration farms. Project personnel checked the time and distance walked to perform different tasks.

Changes in chore operations were then recommended if it was felt that a change could reduce the time of the operation or the distance walked. Subsequent time and motion studies were made to determine the extent to which these recommendations had saved time or distance walked.

Because of alterations in the farming operation, the results of the later time and motion studies were not always directly comparable with the results of the original studies. The most striking savings of time and walking were due to major changes in management or to the addition of equipment. Some of these are noted as follows:

1. The dairy barn on the Black Hawk County farm was changed from the stanchion-type to a loose housing system with a three-stall U-shaped milking parlor. This change in management resulted in a reduction of walking from 5.80 miles a month per cow milked in the stanchion-type barn to 2.59 miles a month per cow milked with the loose housing system.
2. By installing an automatic electrically heated cattle waterer on the Black Hawk County farm to replace a stock watering tank, 420 feet of walking required to tend to an oil-burning stock tank water heater was saved each day.

3. By installing an automatic electrically heated hog waterer on the Black Hawk County farm, walking of 630 feet daily carrying water for pigs was no longer necessary.
4. By piping water under pressure to the poultry house on the Webster County farm, 585 feet of walking carrying water for approximately 300 hens were saved each day.

Table 12. Operating Costs of Electrical Lamps for Pig Brooding

Farm	Washington County		Woodbury County	
	Portable		Central	
Housing				
Year	1949	1950	1950	1951
Brooding period	Jan. 30 to Mar. 21	Feb. 3 to Mar. 4	Feb. 23 to Mar. 31	Feb. 25 to Mar. 20
Sows	36	37	44	50
Pigs farrowed	353	376	449	460
Pigs lost	15	31	63	65
Pigs saved per litter, av.	9.4	9.3	8.7	7.9
KWH used	892.0	669.0	1113.0	1872.0
KWH per litter	24.8	18.1	25.4	37.5
KWH per pig saved	2.6	1.9	2.9	4.7
Av. cost per KWH	\$0.028	\$0.028	\$0.022	\$0.021
Av. cost per litter	0.682	0.501	0.546	0.785
Av. cost per pig saved	0.073	0.054	0.062	0.099

APPENDIX

3. By installing an automatic electrically heated box water on the Hawk County farm, waiting of the last daily carrying water for pigs was no longer necessary.

4. By piping water under pressure to the poultry house on the Webster County farm, 585 feet of walking carrying water for approximately 300 birds was saved each day.

Table 1. Operating Costs of Electrical Equipment for Pig Breeding

Tables showing monthly energy consumption and related information regarding the various applications of electricity discussed in the text are included in this section. Following these are tables showing the connected load for each of the farms.

Year	1950	1951	1952
Brooding period	Jan. 30 to Feb. 3	Feb. 11 to Feb. 25	Feb. 25 to Mar. 11
Sows	18	44	20
Pigs farrowed	152	449	180
Pigs lost	18	63	65
Pigs saved per litter	8.4	7.1	2.8
KWH saved	895.0	1453.0	1875.0
KWH per litter	54.8	33.4	93.2
KWH per pig saved	3.6	2.9	4.1
Av. cost per KWH	\$0.028	\$0.028	\$0.027
Av. cost per litter	\$0.82	\$0.94	\$1.22
Av. cost per pig saved	\$0.073	\$0.065	\$0.092

Table A-1. Annual Electrical Energy Consumption
of Demonstration Farms 1942-51, KWH

Farm	Year con- nected	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
Audubon Co.	1947							4783	5609	7353	8351
Black Hawk Co.	1941	1010	1403	1454	1686	1614	1700	2944	7758	12430	12392
Clayton Co.	1920's	1541	1306	1598	2190	3536	3966	4528	4562	6080	7716
Dickinson Co.	1936					1495	1707	1800	6657	8397	7053
Jasper Co.	1938	2079	3124	5749	3644	7308	8408	9856			
Marshall Co.	1938	6721	6443	5362	6343	6479	9507	16155	18328	19925	19669
Page Co.	1920's	6518	5030	5084	2890	2294	4614	3504	4704	5684	9846
Warren Co.	1940	474	626	804	752	818	1042	1534	8766	12329	
Washington Co.	1939	871	1028	1297	1199	1425	1926	2977	4677	5940	5915
Webster Co.	1941	1384	1828	1484	1420	1826	3766	4144	5531	6536	8509
Woodbury Co.	1941	1041	2294	1968	2735	4791	7277	11427	11501	15461	14731
Average, all farms		2410	2565	2755	2540	3058	4391	5780	7100	9100	10360

Table A-2. Monthly Electrical Energy Consumption
on Demonstration Farms, KWH

	Audubon Co.			Black Hawk Co.			Clayton Co.			Dickinson Co.			Jasper Co.		
	Total	Home	FS*	Total	Home	FS.	Total	Home	FS.	Total	Home	FS.	Total	Home	FS.
<u>1947</u>															
Jan.				220			444			157			696		
Feb.				150			312			150			687		
March				150			324			76			687		
April				150			300			142			687		
May				150			442			121			815		
June				124			320			92			815		
July				106			258			81			815		
Aug.				210			246			245			605		
Sept.				150			216			141			605		
Oct.				94			308			146			605		
Nov.				100			352			181			986		
Dec.				148			444			175			986		
<u>1948</u>															
Jan.	281			230			358			203			986		
Feb.	308			182			468			164			742		
March	308			246			400			152			742		
April	399			72			402			160			742		
May	399			100			304			152			622		
June	518			170			364			145			622		
July	517			150			320			139			622		
Aug.	496			272			344			150			536	396	150
Sept.	496			200			350			152			712	541	171
Oct.	389			556			372			142			850	620	230
Nov.	390			300			440			41			982	722	260
Dec.	492			466			406			200			936	610	326
<u>1949</u>															
Jan.	492			620	344	276	462			350			956	612	344
Feb.	463			849	397	728	468			576			954	600	354
March	464			831	337	494	482			380			1014	597	417
April	537			725	391	334	438			422			1732	485	1247
May	537			447	385	62	350			1218			686	470	216
June	488			482	415	67	302			440			686	475	211
July	489			418	345	73	302			409			528	354	174
Aug.	412			854	348	506a	306			450					
Sept.	412			400	329	71	380			492					
Oct.	412			445	357	83	308			460					
Nov.	412			676	424	252	400			516					
Dec.	854			1111	521	590	364			944					
<u>1950</u>															
Jan.	797	616	181	1447	526	921	466			1116					
Feb.	837	474	363	1490	403	1087	490			780					
March	881	422	459	1349	457	892	426			1080					
April	806	496	310	1043	463	580	602			1214					
May	542	497	45	789	372	417	458			530					
June	458	435	23	742	338	404	448			476					
July	437	426	11	742	363	379	402			466					
Aug.	437	426	11	734	358	376	444			494					
Sept.	511	477	34	762	377	385	485	400	85	561	433	128			
Oct.	432	398	34	734	347	387	505	408	97	550	433	117			
Nov.	396	351	45	1108	469	639	618	458	160	554	400	154			
Dec.	820			1490	542	948	736	501	235	578	414	164			
<u>1951</u>															
Jan.	687			1498	554	944	630	343	287	598	442	156			
Feb.	884	569	315	1356	468	888	580	467	113	665	512	153			
March	768	501	267	1206	500	706	624	406	218	1168	452	716			
April	920	582	338	1449	446	1003	502	358	144	566	420	146			
May	1028			843	364	479	391	333	58	427	334	93			
June	1028			922	391	531	295	252	43	434	339	95			
July	352			845	409	436	388	357	31	409	321	88			
Aug.	352			857	374	483	648	627	21	429	339	90			
Sept.	425			884	462	422	722	680	42	491	393	98			
Oct.	425			800	370	430	874	783	91	546	450	96			
Nov.	747	479	268	752	498	254	1008	796	212	661	579	82			
Dec.	659	480	179	980	485	495	1054	780	274	659	565	92			

* Farmstead

a Short in yard light

Table A-2. Continued

	Marshall Co.			Page Co.			Warren Co.			Washington Co.			Webster Co.			Woodbury Co.		
	T.	H.	FS.	T.	H.	FS.	T.	H.	FS.	T.	H.	FS.	T.	H.	FS.	T.	H.	FS.
<u>1947</u>																		
Jan.	796									321			348			420		
Feb.	507									295			424			390		
March	642									257			938			565		
April	819									105			344			772		
May	971									110			240			601		
June	698									78			248			657		
July	613									117			118			663		
Aug.	629									123			210			516		
Sept.	603									133			212			592		
Oct.	479									91			164			653		
Nov.	1016									123			234			671		
Dec.	1761									173			286			678		
<u>1948</u>																		
Jan.	2122									405	141	262	310			807		
Feb.	2415									361	107	254	274	155	119	785		
March	1944									88	73	15	242	164	78	1228		
April	1373									91	87	4	408	148	260	1159		
May	1146									103	92	11	170	92	78	1122		
June	811									138	104	34	190	159	31	1159		
July	794									125	99	26	225	161	64	1032		
Aug.	788						234			249			217	172	39	985		
Sept.	678						234			249			201	169	32	768		
Oct.	850						234			304	116	188	240	189	51	659		
Nov.	1428						651			370	150	220	523	198	325	780		
Dec.	1806						651			494	155	339	638	255	383	943		
<u>1949</u>																		
Jan.	2346						651			1059	126	933	816	264	552	964		
Feb.	2520						765			690	101	589	664	195	469	1086		
March	2001						766			656	192	464	629	208	421	1087		
April	1949						765			283	176	107	446	211	235	1526		
May	795						881			253	222	31	259	207	52	701		
June	832						881			299	269	30	300	266	34	684		
July	1214						881			321	271	50	201	170	31	677		
Aug.	904						881			295	248	47	344	293	51	836		
Sept.	854						772	396	376	342	293	49	248	181	67	1022		
Oct.	864						939	474	465	479	312	167	248	181	67	778	372	406
Nov.	1338						935	516	419	469	268	201	552	263	289	904	485	499
Dec.	2211						1100	618	482	629	292	337	854	291	563	1238	729	509
<u>1950</u>																		
Jan.	2486						1127	639	488	1187	179	1008	976	238	738	1374	769	605
Feb.	2975						887	421	466	831	255	576	701	264	437	1486	464	1022
March	2317						1062	557	505	753	242	511	308	224	84	2091	604	1487
April	2400						1094	496	598	278	225	53	289	225	64	1497	658	839
May	1629						1023	484	539	265	235	30	434	190	244	1050	533	517
June	956						954	481	473	289	247	42	425	289	136	1064	541	523
July	721						1326	560	766	316	248	68	543	227	316	1070	504	566
Aug.	879						999	477	522	305	261	44	366	196	170	1173	570	603
Sept.	722	702	20				977	496	481	289	252	37	373	175	198	1406	661	745
Oct.	816	694	122				1091	586	505	349	284	65	637	292	345	956	412	544
Nov.	1431	845	586				778	581	197	552	299	253	737	198	539	1405	592	813
Dec.	2543	825	1718				1011	665	346	528	259	269	737	198	539	989	464	525
<u>1951</u>																		
Jan.	3174	1057	2117	653	258	395	983	662	321	528	259	269	1109	514	595	982	597	385
Feb.	2751	1012	1739	653	258	395	863	591	272	786	285	501	638	238	400	1384	487	897
March	1951	832	1119	730	468	262	844	551	293	635	260	375	1558	444	1114	2531	696	1835
April	2093	1039	1054	1167	562	605	844	550	294	882	282	600	727	225	502	1100	549	551
May	1311	940	371	716	525	191	918	577	341	296	266	30	517	352	165	1032	568	464
June	964	813	151	691	506	185				311	279	33	516	351	165	1030	518	512
July	1060	959	101	698	563	135				358	313	45	413	358	55	893	490	403
Aug.	1006	898	108	781	542	239				478	313	165	565	502	63	993	490	503
Sept.	1006	898	108	825	594	231				351	313	38	350	302	48	1022	409	613
Oct.	1128	989	139	701	457	244				358	313	45	426	292	134	1183	602	581
Nov.	1612	756	856	984	572	412				501	324	177	682	342	340	1291	697	594
Dec.	1613	756	857	1287	634	653				595	291	304	1008	452	556	1290	696	594

Table A-3. Energy Consumption of Dishwasher
on Marshall County farm, KWH

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1950									3	4	2	2
1951	3	3	4	3	4	3	4	3	3	3	3	2
Total for 16 mo., 49; Average per month, 3.1.												

Table A-4. Energy Consumption of Home Freezers

	Marshall Co.	Marshall Co.	Page Co.	Warren Co.	Washing- ton Co.	Webster Co.	Webster Co.	Woodbury Co.
Size, cu. ft.	11	16.1	15.8	15.8	18	8	15.5	19.5
Location	Basement	Basement	Enclosed porch	First floor	First Floor	Basement	Basement	Basement
1948								
June						34		
July						41		
Aug.						40		
Sept.						31		
Oct.						31		
Nov.						34		
Dec.						32		
1949								
Jan.						34		
Feb.						29		
March						28		
April						31		
May					84	44		
June					107		95	
July					118		46	
Aug.					140		90	
Sept.				70	98		50	
Oct.				83	84		49	
Nov.				81	84		60	
Dec.				89	68		62	
1950								
Jan.				99	66		63	115
Feb.				79	94		31	164
March				89	74		58	86
April				92	80		57	89
May				98	68		58	95
June				118	94		72	96
July				109	103		71	101
Aug.				109	102		95	106
Sept.	47			96	89		40	159
Oct.	42			112	94		85	82
Nov.	44	73		85	97		45	112
Dec.	37	62		119	87		45	77
1951								
Jan.	45	74	50	111	66		69	90
Feb.	35	67	68	104	78		43	83
March	33	53	42	106	81		74	127
April	43	69	43	106	95		47	93
May	47	78	61	122	109		72	101
June	45	70	69		124		71	97
July	54	87	79		146		83	104
Aug.	52	86	81		148		100	102
Sept.	52	86	62		134			88
Oct.	54	82	50		134			91
Nov.	35	55	37		109			86
Dec.	34	55	31		100			86
Ave. KWH per mo.	43.7	71.2	56.2	91.0	98.8	34.1	64.2	101.3
Ave. KWH per cu. ft.	3.97	4.45	3.56	6.27	5.48	4.27	4.24	5.20

Table A-5. Energy Consumption of Heating Systems

	Black Hawk County	Clayton County	Dickinson County	Jasper County	Marshall County	Webster County	Wood- bury County
Type of Furnace	Oil burner with fan	Oil burn- er with hot water pump	Coal stoker with fan	Oil burner with fan	Oil burn- er with hot water pump	Hand- fired furnace with fan	Hand- fired furnace with fan
Rooms in dwelling	7	8	6	6	7	7	7
<u>1948</u>							
Oct.				19		8	
Nov.				43		17	
Dec.				74		31	
<u>1949</u>							
Jan.				93		42	
Feb.				78		38	
March				55		21	
April				23		7	
May				3			
Oct.						6	10
Nov.						22	31
Dec.						38	43
<u>1950</u>							
Jan.						50	42
Feb.	33					41	26
March	72						20
April	30						8
May	20						1
June							1
July	10						
August	10						1
Sept.	17	5	6		7		4
Oct.	35	12	16		48	34	10
Nov.	83	46	32		118	22	32
Dec.	115	60	51		184	21	20
<u>1951</u>							
Jan.	120	44	51		194	48	24
Feb.	104	57	66		186	5	25
March	95	51	44		146	26	16
April	67	24	28		160	9	3
May	20	6	13		41		
June	14	2	6		8		
July	8						1
August	8		1				1
Sept.	24	8	9		12	4	10
Oct.	50	33	19		53	12	1
Nov.	90	56	49		111	16	25
Dec.	110	67	62		111	38	25
Av. per season	590	305	313	388	1092	162	159

Table A-6 Energy Consumption of Laundry Equipment, KWH

	Clothes dryer, Marshall County	Clothes dryer, Woodbury County	Ironer, Marshall County	Automatic washer, Marshall County
<u>1951</u>				
Jan.	45	31	12	3
Feb.	69	31	23	8
March	56	28	24	4
April	76	23	32	5
May	61	4	31	4
June	54	12	29	5
July	83	5	40	5
Aug.	29	10	39	5
Sept.	30	18	39	4
Oct.	72	26	35	3
Nov.	43	29	23	3
Dec.	42	29	22	2
Average per mo.	55	20.5	29	4.25

Table A-7. Energy Consumption of Ranges, KWH

	Audubon County	Black Hawk County	Clayton County	Dickinson County	Jasper County	Marshall County	Warren County	Webster County
<u>1948</u>								
Aug.					93			
Sept.					113			
Oct.					145			
Nov.					131			
Dec.					142			
<u>1949</u>								
Jan.					118			
Feb.					119			
March					119			
April					133			
May					147			
June					148			
July					184			
Aug.								
Sept.							92	
Oct.							101	
Nov.							96	78
Dec.							104	81
<u>1950</u>								
Jan.	115						108	82
Feb.	87						87	73
March	87						100	94
April	96	81					83	95
May	96	67					102	189
June	106	72					103	128
July	178	71					107	128
Aug.	178	88					145	104
Sept.	66	112	143	166		172	101	129
Oct.	105	82	141	167		126	94	130
Nov.	68	69	137	93		206	78	
Dec.		75	172	72		117	92	
<u>1951</u>								
Jan.		60	132	66		125	88	
Feb.	111	60	203	86		108	88	
March	85	82	169	88		100	83	
April	117	67	168	74		120	83	
May		60	166	57		159	100	
June		74	130	89		139		
July		127	178	67		149		
Aug.		72	171	90		182		
Sept.		142	170	111		182		
Oct.		64	168	111		132		
Nov.	101	71	171	139		106		
Dec.	103	63	158	130		106		
Av. per mo.	106	79	161	100	133	139	97	112

Table A-8. Energy Consumption of Refrigerators, KWH

	Audubon Co.	Black Hawk Co.	Clayton Co.	Dickinson Co.	Jasper Co.	Marshall Co.	Page Co.	Warren Co.	Washington Co.	Webster Co.	Woodbury Co.
<u>1948</u>											
Jan.											
Feb.									43	24	
March									39	25	
April									37	27	
May									37	25	
June									31	28	
July									65	41	
Aug.					51				47	41	
Sept.					40					28	
Oct.					32					24	
Nov.					29				42	21	
Dec.					30				51	21	
<u>1949</u>											
Jan.		17			29				52	21	
Feb.		19			29				46	21	
March		19			32				41		
April		20			39				39		
May		22			40				40		
June		27			59				56		
July		28			61				72		
Aug.		28							88		
Sept.		20						15	51		
Oct.		21						17	45		41
Nov.		20						16	50		41
Dec.		17						15	45		47
<u>1950</u>											
Jan.	26	18						16	50		51
Feb.	25							14	49		37
March	23							16	44		44
April	29							17	47		45
May	30							18	48		49
June	26							23	50		47
July	35							24	60		47
Aug.	35							21	60		49
Sept.	31		28	40		27		17	49		47
Oct.	31		27	36		36		17	46		34
Nov.	25		26	38		16		14	53		53
Dec.			25	30		23		15	46		36
<u>1951</u>											
Jan.	26		20	34		28	29	16	44		46
Feb.	21		26	36		22	51	15	47		38
March	26		27	32		23	24	15	40		45
April			29	35		41	24	16	47		38
May			31	31		21	24	20	54		47
June			28	38		27	24		53		46
July			41	38		40	29		61		50
Aug.			29	39		37	28		69		45
Sept.			26	41		38	34		54		25
Oct.			30	39		35	10		53		44
Nov.	23		26	39		22	24		51		45
Dec.	22		23	43		22	23		49		44
Size, cu.ft.	9	6.2	10.7	6	9	8	8.7	6	8	7	6
Ave. KWH per mo.	27.1	21.2	27.6	36.8	39.2	27.8	27.0	17.0	49.8	26.7	43.8
Ave. KWH per mo. per cu.ft.	3.01	3.54	2.58	6.14	4.35	3.47	3.10	2.83	6.24	3.82	7.32

Table A-9. Operational Data on Storage-type Water Heaters

	Audubon Co.		Black Hawk Co.		Dickinson Co.		Jasper Co.		Marshall Co.		Page Co.		Warren Co.		Woodbury Co.	
	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.
<u>1949</u>																
Jan.			271	470												
Feb.			321	600												
March			269	566												
April			322	664												
May			322	738												
June			353	782												
July			280	490												
Aug.			282	400			178						170	782		
Sept.			262	400			317						200	902		
Oct.			272	380			328						232	1063	203	560
Nov.			250	410			425								272	880
Dec.			291	690			254						294	1252	366	1090
<u>1950</u>																
Jan.	189	791	282	540			287						316	1291	497	1000
Feb.	128	560	210	620			292						266	1194	147	630
March	204	529	192	580			223						283	1194	445	700
April	344	730	220	660			230	715					252	1165	400	1180
May	343	730	197	390			209	584					227	1281	301	940
June	121	750	202	140			173	612					204	1378	302	767
July	203	790	195				153						268	1163	257	
Aug.	203	790	178										265	1117	304	
Sept.	219	790	161	195	184				258				223	905	302	
Oct.	183	630	152	300	182				224				281	1085	178	
Nov.	180	510	196	590	183				140				317	860	222	
Dec.		750	235		204				166				322	1323	171	
<u>1951</u>																
Jan.		720	235	610	221				257				351	1287	262	
Feb.	306	810	196	540	265	580			270	980			301	1865	216	
March	269	800	208	370	234	770			214	760			284	1138	346	
April	294	890	206	280	229	670			292	1030	367	796	283	1138	297	
May			204	310	197	520			332	1110	355	870	288	1328	324	
June			219	150	174	540			274	880	327	860			262	
July			195		181	540			316	1030	276	830			262	
Aug.			218		171	550			279	1315	285	840			240	
Sept.			198	690	188	600			280	1310	290	930			305	
Oct.			170	520	227	700			261	785	230	717			285	
Nov.			216	630	275	920			200	545	308	953			267	
Dec.			192	560	257	810			200	545	362	840			268	
Average per mo.	250	706	237	492	211	655	256	636	248	935	311	848	268	1178	286	861
Water Heated, gal. per person per mo.		118		123		218		212		187		424		236		287
Water Heated, gal. per KWH		2.8		2.1		3.1		2.5		3.8		2.7		4.4		3.0
Tank Size, gal.	40		52		52		52		40		52		30		52	
Temp. rise, degree F.	96		94		--		--		102		96		78		96	

Table A-10. Energy Losses in Farmstead Wiring,
Per Cent of Energy Delivered to Farm

	Audubon County	Black Hawk County	Dickinson County	Marshall County	Warren County	Woodbury County
<u>1949</u>						
Sept.					2.7	0
Oct.					2.5	0
Nov.					2.4	0.8
Dec.					2.1	1.9
<u>1950</u>						
Jan.					1.8	1.7
Feb.	11.1				1.1	7.1
March	5.0				7.2	1.4
April	17.4					2.5
May	2.5				3.3	
June	4.9				3.4	1.2
July	4.9				4.2	2.2
Aug.		3.1			3.3	1.1
Sept.	3.8		4.3	2.3	3.8	2.2
Oct.	3.6	1.5	3.8	2.0	1.4	4.0
Nov.	5.2	1.3	3.6	4.1	2.1	1.8
Dec.		1.4	3.5	12.2	2.4	5.5
<u>1951</u>						
Jan.		1.5	3.0	4.1		2.6
Feb.		1.6	1.2	3.7	0.2	3.1
March		2.2	5.0	5.2	6.6	13.2
April		3.1	4.2	4.2	6.5	4.0
May		1.1	4.5	3.0	1.7	0
June		1.7	5.3	4.8		4.9
July		1.2	5.1	3.0		
Aug.		1.2	5.1	3.2		8.3
Sept.		1.0	4.5	3.4		4.2
Oct.		1.3	6.6	4.8		5.2
Nov.		1.3	2.4	3.7		1.7
Dec.		1.3	0.5	3.7		1.7
<u>Average</u>						
Loss	6.21	1.6	3.1	4.4	2.8	3.6

Table A-11. Operating Data on Poultry Lights

	Clayton Co.				Washington Co.				Webster Co.			
	KWH	Birds	KWH per 100 birds	Ave. hours per day	KWH	Birds	KWH per 100 birds	Ave. hours per day	KWH	Birds	KWH per 100 birds	Ave. hours per day
1948												
Jan.					22			2.8	60			
Feb.					14			2.0	50	330	15.1	18.9
March					13			1.7	43	300	14.3	7.0
April					0				11	300	3.7	1.9
May					0				4	300	1.3	.7
Sept.					0				3	340	.9	.5
Oct.					32	300	10.7	4.1	10	320	3.1	1.6
Nov.					33	300	11.0	4.4	53	320	16.6	8.8
Dec.					36	300	12.0	4.6	63	300	21.0	10.2
1949												
Jan.					33	300	11.0	4.3	74	300	24.7	12.0
Feb.					26	300	8.7	3.7	27	300	9.0	4.8
March					11	300	3.7	1.5	25	300	8.3	4.0
April					0				23	300	7.7	3.8
May					0				4	300	0.8	0.7
June					0				1	300	.3	.2
July					2	294	0.7	0.3	0			
Aug.					7	294	2.4	0.9	2	340	0.6	0.5
Sept.					21	435	4.8	2.8	10	340	2.9	2.8
Oct.					29	430	6.7	3.7	10	320	3.1	2.7
Nov.					29	410	7.1	3.9	41	300	13.7	6.8
Dec.					29	406	7.1	3.7	48	300	16.0	7.7
1950												
Jan.					28	400	7.0	3.6	45	285	15.8	7.3
Feb.					23	400	5.8	3.3	36	250	14.4	6.4
March					19	375	5.1	2.5	32	250	12.8	5.2
April					6	370	1.6	0.8	18	250	7.2	3.0
May					0				2	250	0.8	0.3
Aug.	1	200	0.5		0				0			
Sept.	1	380	0.3		0				0			
Oct.	5	210	2.38		5	300	1.7	0.7	14			2.3
Nov.	12	200	6.0		19	280	6.8	2.5	30			5.0
Dec.	16	190	6.0						30			4.9
1951												
Jan.	13	180	7.2									
Feb.	15	170	8.8									
March	10	120	8.3									
April	9	120	7.5									
Total	82				487				769			
Ave. per year	82				162				256			

Table A-12. Energy used by Yard Lights, KWH

	Jasper Co.		Warren Co.			Washington Co.			
	1948	1949	1949	1950	1951	1948	1949	1950	1951
Jan.		4		7	3		1	1	3
Feb.		2		8	2		0	2	1
March		3		2	2		1	0	2
April		7		0	1		0	1	0
May		3		0			0	1	3
June		4		0			0	0	1
July		4		1			0	2	1
August	4			0			0	3	1
Sept.	4		1	1			1	1	2
Oct.	5		3	4		2	6	4	4
Nov.	8		4	4		2	3	2	5
Dec.	4		1	4		1	1	0	1
Ave. per Mo.		4.42		2.56				1.26	

Table A-13. Milk Cooler Operation Data

	Black Hawk County				Warren County			
	KWH gal. milk cooled	KWH per hundred gallons	Cows milked		KWH gal. milk cooled	KWH per hundred gallons	cows milked	
<u>1949</u>								
Sept.					97	900	10.9	11
Oct.					93	900	10.3	11
Nov.					66	900	7.3	11
Dec.					69	850	8.1	10
<u>1950</u>								
Jan.	100				59	840	7.1	11
Feb.	123				32	800	4.0	10
March	129				30	750	4.0	11
April	123				140	1000	14.0	9
May	128				138	1050	13.1	10
June	138				159	1000	15.9	9
July	137				157	900	17.5	10
Aug.	122				113	900	12.5	11
Sept.	110	1200	9.2	10	81	800	10.1	11
Oct.	106	1200	8.8	11	69	750	9.2	10
Nov.	119	1800	6.6	17	27	810	3.3	10
Dec.	111	1800	6.1	15	29	810	3.6	10
<u>1951</u>								
Jan.	140	2100	6.7	17	8	600	1.3	9
Feb.	119	2100	5.7	19	29	750	3.9	9
March	129	2100	6.1	19	40	750	5.3	9
April	128	1800	7.1	19	60	750	8.0	9
May	156	1950	8.0	19	92	900	10.4	9
June	212	1800	9.4	19				
July	162	1200	13.5	19				
Aug.	164	1200	13.7	15				
Sept.	140	1200	11.7	14				
Oct.	96	900	10.7	15				
Nov.	48	600	8.0	13				
Dec.	38	600	6.3	11				

Table A-14. Milking Machine Operation Data

	Black Hawk County		Clayton County		Warren County		Woodbury County	
	KWH	Cows	KWH	Cows	KWH	Cows	KWH	Cows
<u>1949</u>								
Jan.	24							
Feb.	30							
March	23							
April	24							
May	23							
June	25							
July	18							
Aug.	20							
Sept.	24				11	11		
Oct.	27				16	11	10	5
Nov.	35				15	11	14	6
Dec.	32				19	10	22	9
<u>1950</u>								
Jan.	42	14			18	11	24	11
Feb.	48	15			16	10	14	9
March	43	15			16	11	16	10
April	43	15			13	9	13	8
May	37	15			15	10	14	7
June	36				15	9	13	7
July	38				17	10	14	7
Aug.	39				17	11	17	7
Sept.	29	10	16	11	16	11	22	9
Oct.	39	11	24	19	19	10	18	9
Nov.	58	17	38	21	17	10	19	9
Dec.	65	15	36	21	18	10	17	9
<u>1951</u>								
Jan.	69	17	28	20	16	9		
Feb.	70	19	33	19	14	9		
March	66	19	32	19	16	9		
April	59	19	33	20	16	9		
May	60	19	35	21	14	9		
June	68	19	29	21				
July	49	19	25	15				
Aug.	53	15	12	9				
Sept.	54	14	15	6				
Oct.	42	15	25	18				
Nov.	48	13	32	14				
Dec.	44	11	30	15				

Table A-15. Poultry House Ventilation Data

	Washington County		Webster County	
	KWH	Birds	KWH	Birds
<u>1948</u>				
Nov.	128	320		
Dec.	116	320		
<u>1949</u>				
Jan.	142	300		
Feb.	121	300		
March	57	300	21	300
April	50	300	1	300
May	0	300		
June	0	294		
July	0	294		
Aug.	0	294		
Sept.	90	294		
Oct.	0	435		
Nov.	92	420		
Dec.	14	410		
<u>1950</u>				
Jan.	136	406		
Feb.	120	400	3	285
March	119	400	1	250
April	82	375	8	250
May	0	370	7	250
June	0	350	7	250
July	0	350		
Aug.	0	350		
Sept.	0	350		
Oct.	0	315		
Nov.	12	300		
Dec.	49	280		
<u>1951</u>				
Jan.	78	230	5	300
Feb.	69	230	6	320
March	73	220	8	300
April	68	220	0	850
May	34	210	0	850
June	0	665		
July	0	620		
Aug.	0	439		
Sept.	0	400		
Oct.	0	390		
Nov.	69	361		
Dec.	114	358		

Table A-16. Stock Waterer Operation Data

Farm	Audubon County	Black Hawk County	Black Hawk County	Marshall County	Marshall County	Marshall County	Washington County	Washington County	Webster County	Woodbury County
Waterer Type	Comb.	Cattle	Hog	Comb.	Comb.	Comb.	Hog	Hog	Comb.	Hog
Location	Shed	Barn	Open Lot	Open Lot	Open Lot	Open Lot	Sheltered Lot	Open Lot	Open Lot	Open Lot
	KWH Gal.	KWH Gal.	KWH Gal.	KWH Gal.	KWH Gal.	KWH Gal.	KWH	KWH	KWH Gal.	KWH Gal.
1949										
Jan.							32		428	1402
Feb.							33	110	294	2675
March							14	31	204	1984
April									70	898
May										398
June										733
July										987
August										1700
Sept.										1445
Oct.										1445
Nov.							16	32	180	2210
Dec.			46				47	86	317	2140
1950										
Jan.		68	6870	96	575		63	105	422	2810
Feb.		35	7590	90	115		45	96	415	2550
March	219	6400	6940	69	160		9	28	23	2474
April	233	6000	8250	58	360					2474
May		1590	4010							452
June		1620	150							1050
July		0	40							2290
August		0								2200
Sept.		4450								2030
Oct.		7670	100						88	3770
Nov.		590	8230	31	1960		50	100	451	2725
Dec.		8940	3 10660	61					451	2725
1951										
Jan.		10220	11540	76	3270	874*	1440	284	5750	511
Feb.	264	6680	9920	73	610	548	2630	318	8250	509
March	119	5940	9730	45	1620	385	2070	221	4650	275
April			9490	18	960	295	2290	114	6000	437
May			4890			70	2230	10	1330	19
June			20				1890		520	
July			0				2410		1120	
August			10				1240		4455	
Sept.			0				1200		4455	
Oct.			0				1280		8140	
Nov.	111		5100			213	1340	76	5090	371
Dec.	62		7610	14		213	1340	76	5090	371

* High reading due to shorted thermostat

Table A-17. Dairy Water Heater Operation Data

	Black Hawk County			Warren County			Woodbury County	
	KWH	Gals.	Cows	KWH	Gals.	Cows	KWH	Cows
	water		milked	water		milked		milked
<u>1949</u>								
Sept.				142	741	11		
Oct.				210	801	11	138	5
Nov.				217	759	11	187	6
Dec.				272	876	10	226	9
<u>1950</u>								
Jan.	244			283	833	11	255	11
Feb.	319	226		226	749	10	133	9
March				267	937	11	148	10
April	168			236	918	9	138	8
May	166			224	1000	10	145	7
June	162			211	930	9	145	7
July	168			212	940	10	131	7
Aug.	152	580		216	985	11	163	7
Sept.	157	570	10	197	632	11	202	9
Oct.	161	570	11	230	904	10	158	9
Nov.	214	710	17	191	688	10	260	9
Dec.	242	790	15	330	766	10	202	9
<u>1951</u>								
Jan.	257	830	17	129	742	9		
Feb.	232	730	19	198	780	9		
March	224	710	19	197	798	9		
April	205	670	19	197	798	9		
May	199	680	19	209	878	9		
June	183	660	19					
July	159	610	19					
Aug.	163	630	15					
Sept.	138	510	14					
Oct.	134	450	15					
Nov.	180	550	13					
Dec.	166	540	11					

Table A-18. Pressure Water Systems Operation Data

Farm	Black Hawk County		Jasper County		Warren County		Warren County		Webster County		Woodbury County		Woodbury County		Woodbury County	
Pump Type	Deep Well Piston		Shallow Well Piston		Shallow Well Centri.		Shallow Well Piston		Deep Well Jet		Deep Well Jet		Shallow Well Jet		Shallow Well Piston	
1948	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.	KWH	Gal.
Jan.																
Feb.									16	6670						
March									28	9096						
April									16	8265						
May									21	8267						
June									25	10433						
July									39	16824						
Aug.			14						24	11042						
Sept.			12						25	10124						
Oct.			13						16	7145						
Nov.			10						22	4948						
Dec.			16						14	2488						
1949																
Jan.	16	8750	18						21							
Feb.	17	8750	27						16							
March	16	7500	22						30	8665						
April	24	11500	21	12875					14	6552						
May	23	11000	20	11709					22	7597						
June	31	13400	24	16770					28	7011						
July	35	15700	32	20670					22	5005						
Aug.	43	18200							20							
Sept.	33	13300			96	6792			24							
Oct.	35	13800			99	9193			24		48	29099	9		3	1885
Nov.	31	12100			54	12400			19		61	12200	9	5850	3	2260
Dec.	26	10000			59	18758			26		42	13400	10	5820	2	1980
1950																
Jan.	31	11600			80	20841			13		41	11600	10	5740	3	1735
Feb.	30	11800			57	16333			14		32	21200	6	3350	2	1410
March	27	11000			61	17694			27		45	12620	9	5880	3	1790
April	38	16000			95	16031			26		45	13320	5	2110	3	2250
May	40	16400			129	12159			32		52	22500	5	2355	2	1390
June	31	12200			57	7415			41		51	26000	9	4290	2	1300
July	38	17700			338	7544			87		65	33900	6	2680	2	1355
Aug.	36	18200			43	10431			46		57	29300	8	2440	2	1480
Sept.	47	18500			141	9614			59		69	36100	11	3490	2	1190
Oct.	47	17200			156	12476			65		40	19370	7	3550	1	545
Nov.	53	20500					27	9721	10		45	23100	6	3450	2	882
Dec.	69	24200					18	11645	9		34	17300	7	3280	1	434
1951																
Jan.	60	22800					19	11445	21		34	17140	5	2594	3	1120
Feb.	40	16400					16	10222	17		22	18680	5	1550	4	1592
March	48	18700					14	9251	27		44	11120	8	5090	3	1300
April	46	18800					14	9250	19		41	10220	13	1450	3	1660
May	29	18100					9	6264	32		60	14850	11	2062	4	1316
June	30	13600							32		45	11910	23	4580	5	740
July	36								44		44	21280	5	2058	4	1010
Aug.	50								34		40	19180	4	1608	5	867
Sept.	41								22		137*	17000	8	4040	1	1435
Oct.	28								14		116*	17300	4	5580	4	508
Nov.	32								30		36	13278	8	3060	3	329
Dec.	49								40		36	13270	7	3052	3	329

*High readings due to short circuit.

Table A-19. Connected Load, Audubon County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Coffeemaker	400	:	:	Heating	
Furnace fan	330	:	:	Chicken brooders	750
oil burner	240	:	:	Poultry water warmer	375
Hot plate	1075	:	:	Heating cable	180
Iron	1000	:	:	Lighting	
Ironer	1375	:	:	Barn	350
Lights		:	:	Garage	200
Ceiling lights	1000	:	:	Poultry	200
Floor lamps	100	:	:	Silo and granary	300
Table lamps	225	:	:	Motor driven	
Other	150	:	:	Drill	630
Mixer	100	:	:	Ventilating Fans	125
Radio	200	:	:		
Range	7500	:	:		
Refrigerator	250	:	:		
Sewing machine	75	:	:		
Toaster	860	:	:		
Vacuum cleaner	400	:	:		
Ventilating fan	70	:	:		
Waffle iron	960	:	:		
Washer, automatic	560	:	:		
Water heater	2750	:	:		

Total connected load 22,730 watts

Table A-20. Connected Load, Black Hawk County Farm

Household equipment	Rated load, watts	::	Farmstead equipment	Rated load, watts
Clock (3) 5 ea.	15	::	Heating	
Furnace fan	400	::	Cattle waterer,	
Oil burner	300	::	automatic	500
Iron	1000	::	Heating cable (in hose)	420
Lights		::	Heating tape	100
Ceiling	830	::	Hog waterer, automatic	275
Floor lamps	330	::	Lighting	
Table lamps	875	::	Barn	1100
Mixer	120	::	Granary	100
Radios (2)	325	::	Portable hog houses	1500
Refrigerator	240	::	Motor Driven	
Sewing machine	35	::	Milk cooler 3/4 H. P.	750
Toaster	860	::	Milking machine 3/4 H. P.	750
Vacuum cleaner	180	::	Separator	400
Waffle iron	1150	::	Water Pump 3/4 H. P.	750
Washer	250	::		
Water heater	4000	::		

Total connected load, 17,555 watts

Table A-21. Connected Load, Clayton County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Clippers	50	:	:	Heating	
Coffeemaker	750	:	:	Heat lamps (2)	500
Corn popper	450	:	:	Lighting	
Furnace, oil burner	645	:	:	Barn	500
Water circulating pump	350	:	:	South barn	260
Heater	1350	:	:	Crib	720
Ice cream freezer	375	:	:	Garage	200
Iron	1000	:	:	Milk house	60
Ironer	1740	:	:	Poultry	120
Lights		:	:	Shop	600
Ceiling	1380	:	:	Yard lights	300
Floor lamps	550	:	:	Motor driven	
Table lamps	450	:	:	Air compressor	620
Mixer	120	:	:	Drill (2)	1840
Radios (2)	270	:	:	Emery wheel	440
Range	9810	:	:	Gasoline pump motor	330
Refrigerator	370	:	:	Milking machine	840
Sewing machine	60	:	:	Planer	1100
Toaster	860	:	:	Portable motor	780
Vacuum cleaner	400	:	:	Power saw	140
Ventilating fan	125	:	:	Separator	320
Waffle iron	1150	:	:	Skim milk pump	425
Washer	300	:	:	Water pumps (3)	2560
Water heater	2500	:	:	Other	
		:	:	Welder	7360

Total connected load 45,070 watts

Table A-22. Connected Load, Dickinson County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Clocks (4)	10	:	:	Heating	
Coffeemaker	600	:	:	Brooder lamps (7)	1750
Freezer 19.4 cu. ft.	400	:	:		
Furnace		:	:	Lighting	
Circulation fan	440	:	:	Barn	420
Stoker	330	:	:	Crib	180
Heating pads (2) 75 ea.	150	:	:	Garage	120
Iron (2) 1,000 ea.	2000	:	:	Machine shed and shop	120
Lights		:	:	Poultry	75
Ceiling	2000	:	:	Other buildings	120
Floor lamps (5)	600	:	:	Yard lights (5)	120
Table lamps (2)	200	:	:		
Other (4)	100	:	:	Motor driven	
Mixer (2) 150 ea.	300	:	:	Portable motor 1/3 H. P.	400
Radio	60	:	:	Portable motor 1/2 H. P.	550
Radios (3) 40 ea.	120	:	:	Water pump	940
Range	10040	:	:	Separator	275
Refrigerator (2) 300 ea.	600	:	:		
Toaster (2) 1,150 ea.	2300	:	:		
Ventilating fan (2) 100 ea.	200	:	:		
Washer 1/3 H. P. (2)	400 ea.	:	:		
Waffle iron	500	:	:		
Water heater	2500	:	:		

Total connected load 29,320 watts

Table A-23. Connected Load, Jasper County Farm

Household equipment	Rated load, watts	::	Farmstead equipment	Rated load, watts
Bench saw	400	::	Heating	
Clocks (2)	5	::	Dairy water heater	500
Door chime	5	::		
Fans, ventilating (2)	300	::	Lighting	
Furnace		::	Barn	100
Fan motor	350	::	Hog house	60
Fuel pump motor	200	::	Poultry house	60
Grill	660	::	Yard light	150
Iron	1000	::	Motor-driven	
Lights	660	::	Air compressor	1200
Radio (2)	80	::	Milking machine	350
Range	8500	::	Pump jack	400
Refrigerator	350	::		
Sweeper	350	::		
Waffle iron	660	::		
Washer	350	::		
Water heater	3000	::		
Water pump	350	::		

Total connected load 20,035 watts

Table A-24. Connected Load, Marshall County Farm

Household equipment	Rated load, watts		Farmstead equipment	Rated load, watts
Blanket	150		Heating	
Clocks	20		Automatic stock	
Clothes dryer	4370		Waterers	3400
Coffeemaker	1000		Dairy water heater	2000
Corn popper	450		Engine heaters	1500
Deep fryer	1320		Poultry water warmer	375
Dish washer	550		Soldering iron	500
Freezer 11 cu. ft.	350			
Freezer 16 cu. ft.	550		Lighting	
Furnace, oil burner	170		North barn	2100
Water pump			South barn	1000
Heaters(2) 1, 140 ea.	2280		Crib	400
Heater, radiant	3210		Garage	100
Heating pad	75		Machine shed	600
Hot plate	1000		Poultry house	200
Iron	1000		Shop	1000
Ironer	1620		Yard lights	900
Lights				
Ceiling	2670		Motor driven	
Floor lamps	330		Air compressor	940
Table lamps	200		Clipper	575
Other	100		Grain elevator	1240
Mixer	120		Hack saw	800
Pasteurizer	1500		Emery wheel	1055
Photo enlarger	75		Ventilating fans (2)	2000
Range	6500		Water pump	1460
Refrigerator	250		Water pump (deep well)	1540
Roaster oven	1320			
Sewing machine	60		Other	
Television	260		Welder	8510
Toaster	860			
Vacuum cleaner	400			
Ventilating fan	160			
Waffle iron	1150			
Washer, automatic	805			
Water heater	2000			

Total connected load 69,420 watts

Table A-25. Connected load, Page County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Clock	2	:	:	Heating	
Freezer	630	:	:	Chick brooder	2500
Furnace fan	400	:	:	Grain dryer oven	2200
Heater	1320	:	:	Poultry water warmer	375
Hot plate	2300	:	:	Stock waterers, Automatic (3)	675
Iron	1000	:	:	Lighting	
Lights		:	:	Barn	400
Ceiling lights	900	:	:	Cattle shed	300
Floor lamps	800	:	:	Field house	200
Other	550	:	:	Garage	150
Mixer	150	:	:	Flood lights, feeding	300
Radios (3) 40 ea.	120	:	:	Shop	950
Range	11060	:	:	Yard lights (2) 300 ea.	600
Refrigerator	265	:	:	Motor driven	
Roaster oven	1650	:	:	Air compressor	900=
Television	400	:	:	Corn sheller	600
Toaster	470	:	:	Drill, grinder, buffer	300
Vacuum cleaner	400	:	:	Emery wheel	750
Ventilating fan portable (3) 100 ea.	300	:	:	Feed grinder	1100
Waffle Iron	660	:	:	Forage fan	65
Washer	350	:	:	Grain elevator motor	1000
Water heater	2500	:	:	Portable motor	350
		:	:	Power saw	800
		:	:	Shop motor	2200
		:	:	Silage hoist	1100
		:	:	Water pumps (2)	1360
		:	:	Other	
		:	:	Welder	8500

Total connected load 53,902 watts

Table A-26. Connected Load, Warren County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Clocks (3)	10	:	:	Heating	
Coffeemaker	660	:	:	Dairy water heater	750
Fan, ventilating	75	:	:	Lighting	
Freezer	400	:	:	Barn	100
Iron	1000	:	:	Garage	60
Lights	900	:	:	Milkhouse	60
Mixer	150	:	:	Yard light	150
Radio (2)	80	:	:	Motor driven	
Range	8500	:	:	Milk cooler	1200
Refrigerator	200	:	:	Milking machine	400
Sewing machine	60	:	:	Water pump	1200
Shaver	10	:	:		
Toaster	1100	:	:		
Vacuum cleaner	400	:	:		
Waffle iron	660	:	:		
Washing machine	350	:	:		
Water heater	1500	:	:		

Total Connected Load 19,975 watts

Table A-27. Connected Load, Washington County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Clock (2) 2 ea.	5	:	:	Heating	
Coffeemaker	1000	:	:		
Freezer, 18 cu. ft.	400	:	:	Brooder lamps	3000
1/3 H. P.		:	:	Chick brooder	1500
Heater	600	:	:	Soldering iron	150
		:	:	Stock waterers(3)	775
Iron	1100	:	:		
Ironer	1200	:	:	Lighting	
Lights		:	:		
Ceiling	400	:	:	Barn	200
Floor lamp	300	:	:	Shop	100
Table lamp	100	:	:	Poultry	40
Others	75	:	:	Yard lights	200
		:	:		
Mixer	180	:	:	Motor driven	
Pasteurizer	1300	:	:		
Radio (2) 50 ea.	100	:	:	Air compressor 1/2 H. P.	550
Television	500	:	:	Bench grinder 3/4 H. P.	880
Toaster	1000	:	:	Drill press 1/2 H. P.	550
Vaporizer	200	:	:	Drill, portable	
Waffle iron	1000	:	:	1/4 H. P.	350
Washer 1/3 H. P.	400	:	:	Fanning mill 1/3 H. P.	400
Water heater, 82 gal.	2500	:	:	Separator 1/6 H. P.	275
		:	:	Ventilating fan	100
		:	:	Poultry house 1/4 H. P.	350
		:	:		
		:	:	Other	
		:	:		
		:	:	Welder 180 amp.	8510

Total connected load 30,200 watts

Table A-28. Connected Load, Webster County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Coffeemaker	1000	:	:	Heating	
Freezer 15.5 cu. ft.	400	:	:	Automatic stock	
Furnace fan 1/3 H. P.	400	:	:	Waterer (2)	1585
Iron	1000	:	:	Brooder lamps	2500
Lights		:	:	Poultry water	
Ceiling (8)	730	:	:	Warmers (2)	500
Table lamps (3)	300	:	:	Lighting	
Floor lamps (2)	600	:	:	Barn	240
Others (4)	240	:	:	Crib	120
Mixer	150	:	:	Garage	60
Radio (2)	80	:	:	Hog house	120
Range	11500	:	:	Poultry house	255
Refrigerator	250	:	:	Shop and machine shed	360
Roaster oven	1650	:	:	Motor driven	
Toaster	1100	:	:	Air compressor	350
Vacuum cleaner	400	:	:	Drill	400
Ventilating fan	400	:	:	Emery wheel	1100
Waffle iron (2)	1320	:	:	Planer	550
Washer, automatic	560	:	:	Portable motor	1100
Washer, non-automatic	350	:	:	Power saw	800
		:	:	Separator	550
		:	:	Water pump	550

Total connected load 34,960 watts

Table A-29. Connected Load, Woodbury County Farm

Household equipment	Rated load, watts	:	:	Farmstead equipment	Rated load, watts
Bench saw	400	:	:	Heating	
Clock	2	:	:	Brooder lamps	2000
Clothes dryer	4700	:	:	Stock waterer	100
Coffeemaker	450	:	:	Lighting	
Freezer	550	:	:	Barn	400
Furnace fan	300	:	:	Brooder	100
Heater, space	1350	:	:	Crib	60
Iron	1000	:	:	Hog house	120
Lights		:	:	Yard lights (7)	1300
Ceiling	3200	:	:	Motor driven	
Floor (3)	900	:	:	Air compressor	350
Table	150	:	:	Drill	200
Other (3)	300	:	:	Emery wheel	400
Mixers (2)	240	:	:	Portable saw	550
Pasteurizer	300	:	:	Silage hoist	1500
Radios (4)	150	:	:	Silage unloader	550
Refrigerators (2)	700	:	:	Water pump	1100
Roaster	1650	:	:	Other	
Sewing machine	60	:	:	Welder	8500
Toaster	1100	:	:		
Toaster	450	:	:		
Vacuum cleaner (2)	800	:	:		
Washer, automatic	800	:	:		
Washer, non-automatic	800	:	:		
Water heater	1500	:	:		
Water heater	1250	:	:		
Water pumps (2)	700	:	:		

Total connected load 42,082 watts

